THE

JOURNAL OF GAS LIGHTING.

PUBLISHED MONTHLY

No. 31, Vol. II.] LONDON, AUGUST 11, 1851. [Price 1s., In America 35 Cents.

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NOTICE TO AMERICAN READERS.

Complete series of the Journal may be had of Messrs. D. Appleton and Co., 200, Broadway, New York, to whom all subscriptions for the United States, after the 10th of January, 1851, must be paid.

NOTICES.

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All communications and orders for Advertisements to be addressed to the Editor, 32, Bucklersbury, London.

Back numbers exceeding three months' date will in future be charged double price, unless six or more consecutive numbers are taken at the same time. Nos. 6, 15, 18, and 23 are out of print.

The Editor will be particularly obliged by his friends forwarding to him Notices of all Meetings, Trials, or Appeals which it may be interesting to the Gas World to have reported.

Circular to Gas Companies.

The Editor may be consulted on all subjects connected with the supply and manufacture of gas, or the alteration and improvement of gas apparatus, and the construction of new works.

We have repeatedly alluded to the growing disposition of public men in favour of the system of vesting the supply of gas and water to all large towns in the hands of municipal or other corporate bodies, under the immediate control and responsible to the inhabitant ratepayers. The benefits which the adoption of this system were understood to have conferred on the citizens of Manchester have been constantly appealed to in proof of its excellent working, and were much relied upon by the Government in its recent attempt to settle the metropolitan water question in the parliamentary committee which has just concluded its labours, after upwards of thirty sittings. Four systems found themselves in the presence of each other before this tribunal:—First, that of centralization, under the immediate control of Government, as proposed by the promoters of the bill; second, parochial supply; third, municipal; and, fourth, private enterprise, kept in check by the force of public opinion and the possibility of competition in the event of any abuse of its powers. The two first systems were fully examined by a most able and painstaking committee, and by it unanimously rejected. The evidence in support of the municipal system was confined to Manchester; and, as the rebutting evidence could only be partially heard, the committee did not express any opinion on the other two systems before them, though some revelations of the practices of municipal traders must have shaken the confidence of those members whose bias may have been in favour of municipal supply. The evidence proved that the corporation of Edinburgh had signally failed in their supply of water, and were happy to relinquish it in favour of a joint-stock company, by whom it had been since successfully effected. It was further proved that in the cases of Liverpool, Worcester, and Southampton, the transfer of the supply of water from companies to municipal bodies had been unaccompanied by any improvement in the quantity or quality of the article supplied, but had caused such an augmentation of the rates as to make all political party differences disappear in the storm of opposition created by the imposition of the additional burden; and, instead of Whig or Tory, Radical or Conservative, the only party cries known were "Sanatory" or "Anti-Sanatory" in Worcester, and "Pike"* or "No Pike" in Liverpool; one party endeavouring to carry out the improvements projected, and the other determined at all hazards to stop any further expenditure, and be content with the existing supplies. Manchester owes its narrow escape from a similar agitation to its being able to take £15,000 per annum from the profits of the gas works to make up the deficiency in its water revenue. An attempt to defend such an appropriation was made by the Town Clerk, on the ground that gas was supplied at as low a rate as in any of the adjoining towns; but this was afterwards disproved by evidence, to the effect that, though the nominal price of gas per 1000 feet was only 10 per cent. higher to the Manchester shopkeeper than it was in Liverpool, yet, taking quality into account, light was 64 per cent. dearer in the former town than in the latter; and this is confirmed by Dr. Frankland's experiments on the Manchester gas quoted in our last Journal, as well as by the letter of the consulting chemist to the Manchester gas committee inserted in the present number. It is, however, asserted that, at the period when these experiments were made, no Wigan cannel was used in the Manchester gas works, but an inferior cannel from the neighbourhood; and to this the low illuminating power of the gas is attributed. Such an explanation from a gas company would be severely commented on, and the gas consumers of Manchester will, doubtless, adopt measures to prevent its recurrence. The whole of the evidence taken has been ordered by the House to be printed; and considering the subject of great importance to gas companies generally, and especially to those in places where it has been proposed to adopt the system of municipal supply of gas, we have abstracted such portions as bear upon that system.

It will be seen from our report of the meetings of the commissioners of sewers of the City of London that the selfish majority were ready to lend themselves to another job, and, by their votes, ride over the provisions of a clause introduced by themselves in the act incorporating the Great Central Gas Company, before the sign manual to it was yet scarcely dry. By that clause three months' notice is required to be given before any new main can be laid; and the request made was to allow the whole line of streets from Aldgate to Temple-bar to be at once broken up for the laying of an additional 24-inch main. There can be no doubt of the necessity of this extension, for, though it was asserted that the "leviathan" mains laid by this company in the City of London, were capable of distributing 736 million feet of gas per annum, and earning a rental of £122,666, yet we have evidence that one-third of this amount has scarcely been attained; and that the capabilities of the mains were so taxed on the 9th ult. that

* In allusion to "Rivington Pike," from whence the supply of water was proposed to be obtained.

the pressure given on a first floor of a house in the neighbourhood of Fleet-street was for several hours barely equal to a column of two-tenths of an inch of water. The demand was, however, too barefaced a job for even the little clique of selfish retail traders who constitute the Corporation of the City of London as at present organized, and who claim to represent, or rather to misrepresent, the wealth and intelligence of the first city of the world. Their power is, happily for the public, drawing to a close; and, if the late decision of the House of Lords relative to the Smithfield Market Bill is any index of the state of public opinion, we may speedily look for a change in the constitution of the present corporate body. The advice of the late Lord Liverpool to Lord Ellenborough truly represented the Corporation of his day, and such it has continued to the present. "Let me," said the late earl, "as an old member, give you, who are a young one, a little piece of advice. Never have anything to do with the Corporation of the City of London. Its members are the greatest jobbers I have ever known in the course of my political life." So low, indeed, has it now sunk that only fifteen noble lords could be found to uphold the decision of the committee awarding a paltry compensation for the loss of its Smithfield tolls.

The arbitral tribunal for ascertaining the relative value of the City of London and Great Central Gas Consumers' works has been definitively formed, and is composed of the following gentlemen:—Mr. W. H. Thomas, of the firm of Boyd and Thomas, of Moorgate-street, merchant, is nominated by the City of London Gas Company; Mr. Deputy Harrison, of Cornhill, stationer, for the Great Central Company; with Ross Donnely Mangles, Esq., M.P. for Guildford, and a director of the East India Company, as umpire. Mr. Mangles sat as chairman on the Liverpool Guardian Gas Bill of 1847.

Mr. King has kindly furnished us with the subjoined series of progressive experiments on the illuminating power of Wigan cannel gas, made at a later date than those inserted at page 105 of the JOURNAL for June. They embrace a wider range of consumpt, including experiments on Dr. Fyfe's argand, and in some cases yield better results, but upon the whole confirm the previously recorded ones.

Communicated Articles.

EXPERIMENTS ON THE ILLUMINATING POWER OF WIGAN CANNEL GAS, BY ALFRED KING, ESQ.

JUNE 16TH, 1851.

	½ foot.	1 foot.	1½ foot.	2 feet.	2½ feet.	3 feet.	3½ feet.	4 feet.	4½ feet.	5 feet.	5½ feet.
Single Jet.											
Consumpt per hour	·5	1·									
1 foot = candles	2·15	2·6									
1 foot = grains of sperm	258·3	311·8									
Lancashire Fish-tail No. 0.											
Consumpt per hour	·5	1·	1·5								
1 foot = candles	1·78	2·18	1·76								
1 foot = grains of sperm	214·1	262·5	211·9								
Lancashire Fish-tail No. 1.											
Consumpt per hour	·5	1·	1·5	2·							
1 foot = candles	1·76	2·65	2·55	2·53							
1 foot = grains of sperm	211·3	317·9	306·5	303·7							
Lancashire Fish-tail No. 2.											
Consumpt per hour	·5	1·	1·5	2·	2·5	3·					
1 foot = candles	2·26	3·11	3·5	3·79	3·79	3·66					
1 foot = grains of sperm	271·2	373·3	420·6	455·7	455·7	439·4					
Lancashire Fish-tail No. 3.											
Consumpt per hour	·5	1·	1·5	2·	2·5	3·	3·5				
1 foot = candles	2·26	3·48	3·86	4 07	4·07	4·18	4·1				
1 foot = grains of sperm	271·2	417·4	463·6	488·3	488·3	501·9	492·8				
Lancashire Fish-tail No. 4.											
Consumpt per hour	·5	1·	1·5	2·	2·5	3·	3·5	4·			
1 foot = candles	2·38	3·49	4 00	4·17	4·74	4·5	4·41	4·3			
1 foot = grains of sperm	285·5	419·5	484·4	500·5	566·7	539·9	530·1	516·6			
Batswing.											
Consumpt per hour	·5	1·	1·5	2·	2·5	3·	3·5	4·	4·5	5·	
1 foot = candles	1·83	3·01	3·73	4·1	4·12	4·31	4·3	4·46	4·32	4·4	
1 foot = grains of sperm	220·	361·6	448·3	492·3	494·8	578·1	516·2	535·1	519·	528·9	
Sixteen-hole Argand, small holes in ring, 0·82 in diameter.											
Consumpt per hour		1·	1·5	2·	2·5	3·	3·5	4·	4·5		
1 foot = candles		0·323	1·02	1·9	2·6	3·27	3·72	3·84	3·96		
1 foot = grains of sperm		38·76	123·3	228·7	313·	393·3	446·4	461·7	479·2		
Winfield's Twenty-eight-hole Argand, registered July 25, 1848, with slightly-conical Chimney.											
Consumpt per hour		1·	1·5	2·	2·5	3·	3·5	4·	4·5		
1 foot = candles		0·344	1·16	2·26	2 71	3·5	3·72	3·84	4·		
1 foot = grains of sperm		41·3	139·1	271·3	325·6	420 5	446·4	461·7	481·		
Winfield's Fifty-eight-hole Lucent Argand, registered March 20, 1845.											
Consumpt per hour			1·5	2·	2·5	3·	3·5	4·	4·5	5·	5·5
1 foot = candles			0·318	0·73	1.09	1·57	2·09	2·59	3·07	3·82	4·5
1 foot = grains of sperm			38·2	87·5	131·8	188·4	251·1	311·3	368·9	458·8	540·

Correspondence.

ON THE ANALYSIS OF COAL GAS.

SIR,—In the JOURNAL OF GAS LIGHTING of May last I observe a paper by Dr. Fyfe, "On the Mode of Ascertaining the Illuminating Power of Coal Gas, and on the Comparative Value of Coals for the Purpose of Illumination," in which he states the production of gas from Wigan Parrot or cannel coal at 10,500 feet per ton, containing 7·6 per cent. of olefiant gas. Gas-manufacturers and the gas-consuming public are greatly indebted to Dr. Fyfe for the numerous papers he has published, containing many series of tables apparently very carefully compiled from numerous and long-continued observations; and, if I am not disposed to agree in all that he has stated, but rather to question the accuracy of his method of analysis, I am not the less willing to recognise the merits of his photometrical observations, and the ability with which he has exposed the fallaciousness of other methods of examining gas than his own. Dr. Fyfe has shown how uncertain and dis-

cordant are all the photometric methods at present known of ascertaining the relative illuminating power of gases; and in this he has done a good service to the public rather than to gasmakers, most of whom, it is presumed, have been long acquainted with the facts. There are no results more discordant, and therefore less to be relied upon, than those obtained in the mode they are ordinarily employed, by the shadow-test, or even by Bunsen's photometer. So fully has Dr. Fyfe established this, and so completely must it accord with the experience of all those who have conducted extensive series of observations of this character, that it is not necessary to pursue the subject. Dr. Fyfe has turned to another method of examination, and sought in analysis a refuge from its uncertainties; whilst gasmakers, whose scientific attainments gave them not this resource, conscious of the imperfections of the methods they used, fell back on specific gravity as a valuable adjunct.

A brief statement of the composition of coal gas without reference to the proportions of its constituents, by affording an idea of the objects of the analytical inquiry, will best precede the inquiry into the nature and value of the methods employed.

The gases eliminated from coal or cannel, on distillation in close vessels at a high temperature, consist essentially of olefiant gas, condensible hydro-carbons having a greater number of atoms of carbon and hydrogen condensed into one volume than exist in olefiant gas, light carburetted hydrogen, hydrogen, carbonic oxide, carbonic acid, sulphuretted hydrogen, sulphuret of carbon, cyanogen, nitrogen, ammonia in combination with carbonic, hydrosulphuric, sulphurous hydrochloric, hydro and sulpho cyanic, and possibly some organic acids, and aqueous vapour. Of these all are removed, or ought to be, in the purification, except the olefiant gas, more condensible hydro-carbons, light carburetted hydrogen, hydrogen, carbonic oxide, nitrogen, and a little sulphuret of carbon, for the removal of which latter no good means has hitherto been suggested. The nitrogen probably finds its way almost entirely by rushing as atmospheric air into the retorts when opened, and by leakage of apparatus, &c. The hydrogen and carbonic oxide, though giving out much heat in combustion, yield scarcely any light, burning with a very feeble, pale, blue flame; they only dilute the gas, adding nothing to its illuminating power; the more their place is taken by the other gases therefore, and the better for illumination. The light carburetted hydrogen burns with a yellow flame of no great intensity. The olefiant gas and condensible hydro-carbons burn with a most brilliant white light, and give to the gas its chief illuminating power. The entire illuminating power, then, depends on the olefiant gas with the dissolved hydro-carbons and the light carburetted hydrogen; and the richness and value of a gas may be determined by the proportions in which these exist in it. A correct determination of the proportions of the olefiant gas and hydro-carbons and of the light carburetted hydrogen contained in it will afford a correct and true measure of the quality and value of the gas.

Numerous experiments have satisfied me that the "hydrocarbons" consist of a mixture of Faraday's gas, $C_8 H_8$, and propylene, $C_6 H_6$.

Though I did not examine them photometrically, I have frequently experimented with the lights yielded by light carburetted hydrogen prepared by Dumas' method, that of olefiant gas from alcohol, and Faraday's gas condensed by great pressure from oil gas. Any one who chooses to repeat them will be surprised at the low amount yielded by light carburetted hydrogen and the brilliancy of oil gas, $C_8 H_8$. With isolated propylene I have made no trials.

The test of specific gravity has been much employed and greatly relied upon; but this, even if it were trustworthy, which it is not, could afford only a very crude idea of the general quality of the gas, without giving any knowledge of its constituents. The heavier the gas, it is said, the better is its quality. Now, the specific gravity of carbonic oxide is 967·79; of olefiant gas, 985·2 practically, though theoretically the same as carbonic oxide; nitrogen, 971·37; and light carburetted hydrogen, 559·6. It is evident that a gas containing much carbonic oxide, or even nitrogen, from leakage, very little olefiant gas, and an inferior amount of light carburetted hydrogen, and consequently very poor in illuminating power, could weigh heavier, and seem better by this test, than gas of far higher quality. The test has no value but as an adjunct to analysis.

The employment of chlorine in the analysis of gaseous mixtures originated with the late Dr. Henry, to whose beautiful researches on coal gas chemists have hitherto added but little. "Olefiant gas," says Dr. H., "mixed with one or more of the following gases, viz., hydrogen, carburetted hydrogen, carbonic oxide, or nitrogen, may be detected and estimated as follows:—Into a graduated tube about $\frac{8}{10}$ths of an inch in diameter pass twenty, twenty-five, or thirty measures of chlorine, observing its quality when actually in the tube, which is then to be shaded from the light by an opaque cover of tin or pasteboard. To the chlorine pass up fifty measures of the gas under examination; let the mixture stand ten or fifteen minutes, and then gradually raise the cover till the surface of the water within the tube appears. Note the diminution, and divide its amount by 2, which will give the quantity of olefiant gas." To this plan there lay the objection, amongst others, that during the operation a portion of the chlorine itself underwent absorption, so that the result of the division gave a higher amount of olefiant gas than actually existed in the mixed gases. To obviate this Dr. Fyfe proposed to observe, first, how much chlorine was absorbed alone by the confining water, and then to deduct this amount from the total volume absorbed, dividing the remainder as before. Dr. Fyfe seems to have relied greatly on this method, to have adopted it entirely in his examinations, and has vaunted it as the only method worthy of confidence. And still it has no claim to be considered as an exact scientific process, and is one which will never be adopted by chemists accustomed to gaseous analysis and acquainted with the present state of pneumatic chemistry. It is, indeed, inferior to the process subsequently adopted by Dr. Henry, of washing out the chlorine by solution of caustic potass and estimating directly the olefiant gas. To Dr. Fyfe's process there lay several grave objections, whilst chemists are acquainted with processes so much more accurate and free from objection that it may well be considered as obsolete. The rate of absorption of chlorine varies with the diameter of the tubes employed, with the temperature of the water, and still more with the state of dilution of the chlorine itself by another gas. Some years ago I made numerous experiments to determine whether chlorine could be employed so as to give tolerably exact results, but soon abandoned it. I select two from my experiments to show how the rate of absorption varies with the dilution of the chlorine.

1. Passed 2·9 cubic inches of nearly pure chlorine, collected over water that had been boiled to expel atmospheric air, into a graduated eudiometer standing over water at 50 deg. Fahr. The gas measured 1·9 cubic inches. After standing fifteen minutes it measured 1·68 cubic inches, showing an absorption of twenty-two parts.

2. Passed equal measures of chlorine and atmospheric air into the same eudiometer. After fifteen minutes the gas had suffered absorption to the extent of ten parts. The inequality, therefore, in the same time and under the same circumstances, was very great.

Another source of error is the formation of a quantity of chlorine ether, the tension of the vapour of which is not accurately known.

Dr. Henry's method of allowing the chlorine and gas to react on each other, removing the excess of chlorine by an absorptive solution, and determining the amount of olefiant gas by the diminution in bulk of the original quantity employed, is a better one. This method I have subjected to a rigid examination. Pure chlorine is recommended to be employed, but it is almost impossible to obtain pure chlorine over water; and mercury absorbs it so rapidly that experiments cannot be performed over this metal by chlorine. I have prepared chlorine from perfectly pure materials in vessels completely filled with fluid so as to expel all air, and collected the gas over boiled water, and still, on acting upon it by an absorptive solution, there was always a residuum left. I collected the residuum from several operations, and analyzed it. I found it to be composed entirely of atmospheric air. Unless the exact proportion of this be accurately determined, it will vitiate the results of an analysis with chlorine, because it must be allowed for, which has not generally been done. Unfortunately, the proportion of this unabsorbable residue varies with every portion of chlorine collected, and, therefore, the examination of one bottle of chlorine does not give the true amount of impurity to be allowed for in that employed for the analysis. From the same quantity of chlorine I obtained in one instance ·025, in another ·0375, in a third ·03, as the amount of residuum. The impurity proceeds from the air mechanically retained or absorbed by the water and other fluids employed in the processes. This is displaced by the more absorbable chlorine, and hence its constant presence in the unabsorbed chlorine, and the constant variation in its quantity.

During several years I employed the method last described for separating the olefiant gas and its associated higher carbo-hydrogens, using the same bottle of chlorine for acting on the gas, and for estimating the impurity to be allowed for. The experiments were made with careful exclusion of light from the mixed gases, and any variation of temperature or pressure carefully noted and allowed for. The residual gas, consisting of light carburetted hydrogen, hydrogen, carbonic oxide, nitrogen, and sometimes a little oxygen, was then analyzed over mercury by explosion with oxygen in the usual way. A very important addition, however, to the methods previously used, I conceived to be the determination of the number of volumes of oxygen consumable by the gases removed by chlorine, and the quantity of carbonic acid produced in the combustion, as thereby was obtained a measure of the illuminating power of the gases removable by chlorine. This method I have always adopted in my examinations.

Some years ago Professor Bunsen, of Marbourg, finding the difficulty of truly determining the amount of olefiant gas in a mixture by chlorine, proposed the use of charcoal, or coke balls, saturated with fuming sulphuric acid, for the removal of the olefiant gas; and so beautifully does this accomplish the object in view that it has entirely superseded, in the hands of scientific chemists, all previous methods in use.

An approximative method of determining the general value of a gas, and which is also due, I believe, to the late Dr. Henry, consists in firing the mixed gases with oxygen by electricity in graduated

tubes over mercury, and determining the amount of oxygen consumed, and of carbonic acid produced.

The complete analysis of such a mixture as is contained in coal gas is an operation requiring great care, both in the manipulations and in the use of the materials employed, and is not to be accomplished by persons unaccustomed to analytical processes. The instruments employed require great care in their construction and verification. On these points ample instructions have been given by Professor Bunsen, whose mode of calibrating them is by far the best in use. A constant reference is required to the barometer and thermometer, which should also be standard instruments. The operations are all performed over mercury, and the exact value of the meniscus in each eudiometer used should be accurately ascertained, so as to be allowed for in each admeasurement. In reading off quantities either a telescope should be used, or a sliding mirror adapted to the eudiometer, so as to enable the operator to bring the pupil of the eye into the same plane with the top of the meniscus of the mercury.

For many years I have employed the sulphuric acid recommended by Bunsen, using, however, the perfectly anhydrous acid obtained by distilling the fuming acid of Nordhausen. I first explode a quantity of the gas with a large excess of oxygen, so as to avoid the formation of nitric acid, determine the amount of oxygen consumed, and of carbonic acid produced.

From another portion of the same gas I remove the olefiant gas and associated carbo-hydrogen by a bullet of coke saturated with anhydrous sulphuric acid, removing the sulphurous acid afterwards by a ball of moistened peroxide of manganese. Any little moisture left by the latter may be removed by caustic potass; any oxygen in the gas may be removed by a bullet of phosphorus, or by solution of pyrogallic acid. The wires supporting the balls should be of platinum.

The residual gas is now transferred, or, rather, a portion of it, to a longer eudiometer perforated in its upper part by platinum wires, and exploded with a considerable excess of oxygen, the number of volumes of oxygen consumed determined, and of carbonic acid produced. The excess of oxygen is now removed by explosion with hydrogen, and the amount of nitrogen in the original gas determined. We may now calculate the proportions of light carburetted hydrogen, hydrogen, and carbonic oxide in the mixture. In all the operations the exact height of the mercurial column, as well as the temperature and pressure of the air, must be noted.

The first and last operations give us the difference between the volumes of oxygen consumed and of carbonic acid produced by the original gas, and the same gas after having been acted on by sulphuric acid; and, therefore, the number of volumes of oxygen consumed by the olefiant gas and carbo-hydrogens removed. This part of the process I regard as of the greatest importance; for the mere number of volumes removed by the sulphuric acid or the chlorine does not directly give the value of these, as they vary exceedingly in composition, requiring different proportions of oxygen for their combustion. Different gas-producing materials give very different results in this respect, and it is one which has hitherto been altogether overlooked by gas chemists. I communicated this method to my friend Dr. Frankland, who, availing himself of it in his researches on the mixed resin and water gas, published in your last number, discovered a considerable difference in the gases absorbable by sulphuric acid, in the resin gas and cannel gas.* I perceive that Dr. Frankland has stated the per centage of olefiant in the Manchester gas at 5·5, which is correct for the present production, but does not represent the average amount in the Manchester gas. It happens that for a while, during the long days, we have not been using Wigan cannel at all, but a cannel from the immediate neighbourhood. Scarcely any gas being required just now for the mills or shops, we have been using up some old material. The Wigan cannel of Ince-hall yields us regularly 11,800 feet of gas per ton, containing from eight to nine per cent. of olefiant gas. Indeed, the average produce for the last six months that we have used this cannel has been 11,820 feet per ton. Last year's average was 11,500.

I append a few analyses, taken from a large number that I have made, of the gas produced in this quantity from the Ince-hall cannel:—

I.

100 volumes of the gas required 147 volumes of oxygen for complete combustion.

100 volumes of the same gas, being treated with anhydrous sulphuric acid, lost 8·5 parts, consisting of olefiant and other condensible hydro-carbons. The residual gas required 104 volumes of oxygen for combustion, so that the 8·5 parts which had been removed by the sulphuric acid had required 43 parts of oxygen for combustion.

Now, 1 volume of olefiant gas requires 3 volumes of oxygen only for combustion, whereas 1 volume of the gases removed by the sulphuric acid required 5 volumes of oxygen as nearly as possible; showing that the illuminating gases in coal gas do not consist of olefiant gas only. The analysis being completed gave the following results:—

Carbonic acid and aqueous vapour	1·53
Olefiant gas and illuminating hydro-carbons, represented by 43 volumes of oxygen	8·59
Atmospheric air	4·32
Light carburetted hydrogen	34·02
Hydrogen	41·00
Carbonic oxide	11·35
	100·72

II.

Carbonic acid and aqueous vapour	1·40
Olefiant gas and associated carbo-hydrogen	8·35
Oxygen	0·90
Nitrogen	3·42
Hydrogen	37·88
Light carburetted hydrogen	41·40
Carbonic oxide	6·66
	100·01

III.

Gas previously dried by potass.

Olefiant gas, &c.	9·21
Oxygen	0·16
Nitrogen	5·37
Hydrogen	42·33
Light carburetted hydrogen	38·08
Carbonic oxide	4·84
	99·99

IV.

Carbonic acid and aqueous vapour	2·32
Olefiant gas, &c.	8·51
Oxygen	0·46
Nitrogen	6·38
Hydrogen	37·84
Light carburetted hydrogen	38·40
Carbonic oxide	6·10
	100·01

London Gas from Newcastle Coal.

Olefiant gas, &c.	3·83
Oxygen	0·46
Nitrogen	1·61
Hydrogen	32·83
Light carburetted hydrogen	37·63
Carbonic oxide	3·64
	100·00

JOHN LEIGH,
Consulting Chemist to the Manchester Gas Committee.
Manchester, July 18, 1851.

* Dr. Frankland has called my attention to the fact of his having employed this method of analysis in his experiments on the isolation of the organic radicals in 1849. I was not aware of this till my paper was finished. It has, however, not been used by other chemists, I believe, in the analysis of coal gas, nor by him till this period.

Register of New Patents.

GEORGE HENRY BACHHOFFNER, of Grove-road, St. John's-wood, and NATHAN DEFRIES, of Grafton-street, Fitzroy-square, civil engineer, for "*improvements in obtaining light and heat, and in apparatus connected therewith.*" Patent dated Dec. 19, 1850.

The first part of this alleged invention consists of an improvement in candles, the object of which is to render snuffing unnecessary, and at the same time to keep the wick of the candle in a central and vertical position. According to the patentees' statement a short piece of wick may be caused to continue during the combustion of the candle. To effect this a piece of cotton wick, of about three quarters of an inch in length, is prepared in the ordinary manner, either plaited or plain; this is bound round with a piece of common binding-wire, to the extent of about one quarter of an inch from the bottom, which prevents the combustion of that part of the wick, and also serves to attach the elastic substance by which the wick is held in position. The candles are moulded in the ordinary manner of hollow-moulded candles, that is, with a hole throughout the centre. A small piece of tube, about half an inch in length, having a collar near one end, is employed to retain the wick in its proper position. This tube is of porcelain or other material, whereby the heat is prevented communicating to the candle too rapidly. The wick is placed upright in the short end of the tube, the other end being placed in the hole at the top of the candle. The flexible material before mentioned consists of an indiarubber ring, of about three quarters of an inch in diameter; this, being fastened to the wick by the binding-wire, is extended and drawn down through the hollow of the candle, and is there fixed by passing a piece of wood through the ring at that end. By this means the wick is held in position, and rests in the porcelain tube, the pressure being borne by a flange or collar resting on the material of the candle. Thus, as the candle becomes consumed, the wick will be drawn down by the indiarubber ring, and thereby always kept immersed in the melted matter of combustion. The wick is thus also kept in proper position throughout the entire combustion of the candle.

The second part of this invention refers to modes of producing a bright incandescent fire, in imitation of an ordinary fireplace. For this purpose a grate, somewhat similar to a common firegrate, is

employed, the bottom bars for this purpose being perforated iron tubes for the admission of the gas as commonly employed in its combustion for the purpose of heating; or the ordinary bars of a grate may be covered with wire-gauze, platinum foil, perforated talc, or iron balls, as will be hereinafter explained. Beneath this three or more rings of gas jets are allowed to discharge, so as to pass through the perforated talc or wire-gauze, on the top of which are placed shreds, parings, or thin plates of metal, or the metal platina in a finely divided state, commonly known as spongy platina. In lieu of the platina the patentees also employ a composition which is well adapted for the purpose, and is comparatively of little cost. The substitute for the spongy platina is composed thus:—With a saturated solution of the sulphate of copper mix a saturated solution of bichromate of potash; then add to the mixture a solution of carbonate of ammonia. Instead of the above salts being used in solution they may be employed in their ordinary crystalline state in the following proportions:—

152 parts bichromate of potash,
125 parts sulphate of copper,
39 parts carbonate of ammonia.

These are to be first separately dissolved and then mixed together. A precipitate of a brown-yellowish colour is thrown down (called a basichromate of copper); this, when washed and dried, is subsequently submitted to a red heat in a crucible, after which it is in a state fit for the purpose required, and as a substitute for the spongy platina. This compound may either be used as thus prepared or with the addition of asbestos, but for which the patentees do not make any claim other than when used for the purposes herein implied. The gas, being emitted and allowed to play among the above bodies, becomes mixed with atmospheric air and ignited, so that the whole mass assumes a bright incandescent appearance, producing a great amount of radiant heat, and having at the same time an appearance very much resembling a coal or coke fire. Instead of the materials before mentioned, any other materials not subject, or only slightly subject, to oxidation, and without being fused on being brought to a red heat, may be employed; but, at the same time, giving preference to lamina of iron or platina. The latter metal is better adapted for the purpose, as it admits of being reduced to the thinnest lamina. Several modifications of this kind of fire are represented, but which vary mostly in the form of grate used for the combustion of the gas.

The second improvement under this head consists in the burning of what is commonly known as diluted gas, which is accomplished by passing the gas through wire-gauze or lumps of pumicestone before it is allowed to ignite; by this means a pale non-fuliginous flame results. In the use of wire-gauze for this purpose it is subject to oxidation, and soon becomes broken in the meshes, by which the gas gets ignited below, thereby producing a smoky flame. The improvement suggested is the substitutisn of platina foil or perforated talc, having not less than thirty holes to the square inch. The talc is perforated in the ordinary manner of perforating paper or zinc, as well understood. In the combustion of diluted gas, producing an imitation of an ordinary fire, the patentees also employ, as a substitute for the pumicestone or lamina of platina, or materials before described, a series of iron balls, varying from one-eighth to half an inch in diameter; these are piled in a case close around the sides, below which the jets of gas are emitted from three or more perforated tubes placed under the grating which supports the balls. The pile of balls is three or four inches in thickness, and the gas on passing through becomes ignited, which renders the whole mass of a red heat, and representing a bright incandescent appearance in imitation of a coke or coal fire, at the same time possessing a great amount of radiant heat.

A modification of this arrangement is adapted for a stove; for this purpose the balls used are an inch in diameter, and piled in a casing suitable as a stove to the extent of eighteen inches or two feet. The gas is admitted with the requisite amount of atmospheric air at the bottom of the stove, which imparts the necessary heat to the balls, the products of combustion passing off by a pipe from the top. The whole mass of balls, being heated, possess a great amount of radiant heat, which is transmitted through and radiated from the stove. A gas apparatus is represented for the purposes of ventilation, in which the heat of the gas ascends a tube placed within a casing similar to a pedestal stove, and is conducted down to the floor and away to the chimney. The supply of air is admitted to the burner by a pipe from below, which pipe terminates near the ceiling of the room. The air is then drawn from that part of the room where it is more vitiated. The ventilating apparatus will thus serve as a stove to heat the room; also, should heat be unnecessary, and a draught exist in the chimney, the gas may be shut off after the course of the air has been established thereby.

The next improvement refers to an apparatus for cooking, which, in its general arrangement, is similar to the ordinary gas-cooking stove, having in addition thereto two vessels for steaming. These vessels are placed one on either side of the stove, projecting their extent beyond the limits of the stove. These vessels consist of two receptacles for water, forming boilers, having interior chambers, into which the steam evaporating from the water in the boilers is conducted by pipes over the upper edge of the steamer down to the bottom of that vessel, where it is allowed to escape below the substances to be cooked. The steam from the boilers is passing off in any other way to ensure the passage of the steam to the steaming-vessels. The heat of the gas used for other cooking purposes is thus also available for boiling water and steaming as described.

The last part refers to a pedestal gas-stove, adapted for the heating of fluids. This stove has an outer and an inner casing, between which water is placed, forming a boiler, which is maintained at a height above the inner casing; worm-pipes are placed in this vessel or boiler, having funnels at the top of the stove, into which any fluid to be heated is to be poured. The worm-pipes have suitable taps at the bottom of the stove, by which the fluids, when heated, are drawn off; as also the hot water from the boiler. The heat from the gasburner, after passing up the centre of the inner casing, impinges on a dome-top, and is conducted down in contact with that surface and carried off by a suitable draught.

In conclusion, the patentees observe that they are aware it has before been proposed to employ the flame of gas from hollow bars or pipes acting on pumicestone: they do not, therefore, make any claim thereto, so far as regards employing gas to produce an incandescent fire. But what they claim is:—

First. The use of indiarubber springs to draw down the wicks of candles.

Secondly. The means and apparatus described for burning gas for the purposes of heating.

Thirdly. The mode herein described of constructing shades for lamps.

Joshua Horton, of Ætna Works, Smethwick, in the county of Stafford, steam-engine boiler and gasholder manufacturer, trading under the firm of Joshua and William Horton, for "*improvements in the construction of gasholders.*" Patent dated Jan. 2, 1851.

The object of the present improvements in the construction of gasometers is, to dispense with the employment of the usual lofty framework and columns from which it is suspended, and to substitute traversing-guides or standards, fixed to the gasometers themselves, and which are constructed as follows:—Upon the top or upper edge of the outer or fixed portion of the gasholder are fixed several vertical guide-standards, placed at about equal distances apart, around the gasholder; the height to which these extend will depend upon the height of the rise of the moving portion of the gasholders, the tops of them being about equal to the extreme rise of the gasholder; should these guide-standards not be thought of sufficient stability of themselves, they may be connected and braced together by means of rods. The inner edges of these guide-standards are of the form of an edge rail, against which flanged wheels or rollers attached to the moving part of the gasholder traverse; these wheels are supported by brackets fixed to the sides of the gasholder, near the top of it. Each vertical guide-standard has one of these wheels or rollers bearing and working against it; thus the upper part of the moving portion of the gasholder is guided and retained in its proper position during its traverse up or down, as the gas contained is increased or diminished in quantity. Inside the fixed or lower portion of the gasholder vertical bars or rails are riveted; the positions of these may correspond with the vertical guide-standards before described; these bars or rails are riveted to the inside of the fixed part, and form guide-rails, against which wheels or pulleys are attached to the lower part of the moving portion of the gasholder. These pulleys or wheels are attached by means of brackets similar to those upon the upper part of the gasholder.

The third improvement consists in the construction of the hydraulic cup, or joint, between the moving and the fixed portions of gasholders. In the usual mode of forming and making these, angle-iron is employed, to which the flat bottom and the sides of the cup are riveted. The present improvement consists in dispensing with the angle-iron, and bending up the edges of the plates, forming the bottom of the cup, to right angles to the bottom; to these bent-up portions the plates forming the sides are riveted in the usual manner. This mode of construction dispenses with the use of the angle-iron, and also with the double row of rivets necessary when angle-iron is employed; and also has the advantage of being considerably lighter in weight.

The patentee claims:—

First. The application and use in gasometers or gasholders of vertical travelling guide-standards, fixed to the lower or fixed portion of the gasholder, against which guide-standards, or anti-friction rollers or wheels, are adapted to work, which anti-friction wheels or rollers are attached to the moving part of the gasholder, these being arranged so that the wheels or rollers may work against the vertical guide-standards, as the moving part of the gasholder rises or falls, by reason of the increase or diminution of the quantity of gas contained therein; and by these means the moving part of the gasholder may be maintained, and move with facility in a vertical position.

Secondly. The application and employment of fixed guide-rollers, bars, or rails, instead of being loose as usual, such being riveted to, and forming part of, the gasholder; and against the edges of which the anti-friction wheels or rollers move and work as described.

Thirdly. The method described of constructing the hydraulic cups or joints or cups of gasholders, or any other mere modification thereof, in which the bottom or the top of the hydraulic joint or cup is formed, and made of plates of iron bent up into a cup-shape at their edges, without the necessity of employing angle-iron, in the construction of such hydraulic cups or joints.

Parliamentary Intelligence.

SELECT COMMITTEE ON THE METROPOLITAN WATER SUPPLY.

This committee, consisting of Sir James Graham (Chairman), Sir John Hanmer, Mr. Beckett, Mr. John Ellis, and Mr. F. Sandars, assembled on the 24th of June, and continued its uninterrupted sittings till Aug. 4th, when it came to a resolution rejecting the preamble of the bill introduced by the Government for amalgamating the several metropolitan water companies into one company, under its immediate control, and adjourning till next session the further consideration of the various other projects referred to their consideration.

In the course of the evidence, Manchester was cited as an instance of the advantages resulting to the public from the supply of gas and water being in the hands of the municipal authorities. The opponents of this principle maintained that the price of gas in Manchester was much higher and the quality inferior to that in some of the neighbouring towns, where the supply was in the hands of joint-stock

companies, and that the gas consumers were consequently heavily taxed to cover the expenditure of £1,000,000 improvidently wasted in obtaining a supply of water. The following are from the minutes of the evidence given upon these points:—

JUNE 26TH.

Mr. *Joseph Heron*, town clerk of Manchester, examined by the COMMITTEE.

574. Are the gas works in the hands of the town council?—They are.

575. Nobody pays for gas except those who use it?—No, certainly not; it is an entirely voluntary taking.

576. But the voluntary takers of gas are contributing to the extent of one moiety of all that is paid in aid of the water-rate?—No doubt they are; the gas ratepayers are substantially the inhabitants, but they are not so entirely; and therefore if they could not show, or rather if the corporation could not show, that the gas is supplied cheaper than any other town similarly situated where competition is admitted, they might have a right to complain, but that is not the case.

577. If you take £15,000 a year from the gas-rate, cheap as your prices are, they might be cheaper still?—Of course that is so; but the gas works do not belong to the borough; the gas works were originally established, and now are the property of the township of Manchester, which is one of the townships within the borough; the arrangements which have been carried out have been these, that to the extent of one-half of the gas profits, seeing that those profits were to a certain extent obtained by the gas sold in the different out-townships, those out-townships should share with Manchester in the benefit of that expenditure, and half the gas profits have been divided between Manchester and the out-townships within the borough (though they have not one shilling of the property in the works) in making improvements; therefore the simple question which the council had to determine was, whether it would be a greater improvement, and of greater benefit, to get this large supply of water than to have this half of the gas profits expended in improving the streets, and it was found generally that the expenditure in obtaining an ample supply of water which would hereafter result in revenue would be of the greatest benefit.

578. Is the district supplied with gas co-extensive with the district to be supplied with water?—Substantially it is the borough; the districts out of the borough have no interest in our waterworks.

579. The district to be supplied with water is larger than the district to be supplied with gas?—No doubt it is, but beyond the boundary of the borough the inhabitants that we supply have nothing to do with the supply of water; as far as the rates go, and for which alone our gas profits are applied, the district is coextensive.

580. Has the bill you speak of received the sanction of Parliament yet?—It is in the House of Lords.

581. But it is not yet passed?—It is not; there is no opposition to the bill.

582. Mr. JAMES.] No person taxed to the gas complain?—No.

583. By the COMMITTEE.] What is the price you charge for gas in Manchester?—I believe it is from 4*s.* to 5*s.*; 5*s.* is the highest price; I think in some cases it goes below 4*s.* a thousand feet.

584. Is this intention to obtain power to bring the receipts of gas in aid of water known generally in Manchester?—Unquestionably it is; it has been discussed in the town council, and there has been one unanimous feeling in favour of it; the inhabitants are perfectly satisfied that they have their gas as cheaply as they have any right to ask for it; gas is cheaper in Manchester than they get it where they have the full benefit of that competition for which I presume some gentlemen would contend; at Manchester, where there is a monopoly in gas, we get it cheaper than where there is full competition.

585. If this £15,000 to be taken from the gas and given to the water were remitted in the price of gas, the price of gas in Manchester would be reduced to that extent?—Yes, it would, but that would be very unjust to the owners of the gas works; gas is furnished to the gas consumers at a price unreasonably low, which they have no right to expect gas at; and it is depriving the owners of the gas works of the advantage of a fair price being obtained; the owners of the gas works are the whole of the inhabitants, but the gas consumers are only a portion of the inhabitants; therefore, we say this, the gas consumers, we admit, have a right to have their gas as cheaply as they can show it is obtained in any town, no matter where, as the result of competition; but they have no right to have it one farthing cheaper, because the works do not belong to the gas consumers, they belong to the inhabitants, and the profits obtained by the fair sale of gas must be expended either as we propose, or in making improvements of streets, as they have been for the last fifteen years; and it is a great concession on the part of the inhabitants to say, we will allow a portion of these profits to go, in fact, in reduction of the charges upon the whole borough, though the whole borough are really not the owners of the works.

586. When your Water Bill shall be in full operation, as it will be in the course of three or four months, the supply of water to Manchester, and the supply of gas to Manchester, will be in the same hands, namely, in the municipality, representing the community?—Undoubtedly; and that municipality, as the result of our having the gas in our hands, has been enjoying the benefit of the expenditure of nearly £40,000 a year, in widening their streets and improving the town.

587. And the conduct of this representative body, in respect to the supply of both articles, and the prices charged, is exercised by them in open assembly, in the presence of the ratepayers, and subject, by election, to the control of the ratepayers?—Certainly; and we have had in years gone by a gas agitation, and we should have it to-morrow if we were to raise the price one farthing above what they could show was the price arising from the greatest possible competition.

588. What is the actual price charged for gas in Manchester?—I cannot state it nearer than that it is from 4*s.* to 5*s.* 1000 cubic feet; I believe it does not go above 5*s.* for the smallest quantity; but I rather think that recently there was a reduction made below 4*s.* for the largest quantities; but this I can add, that many of our largest mill-owners, who have had gas works on their premises, are now allowing those gas works to go to ruin, because they find they can get gas from the corporation cheaper than they could make it.

589. Are you not able to give a specific answer to the question, what is the exact price of gas at Manchester, not only what is the charge to private consumers, but what is the charge for the public lamps?—I will endeavour to get that information.

590. How would the gas profits be applied to the improvements of the streets?—The whole of the gas profits, by act of Parliament, are applicable to the improvement of the township of Manchester; but, seeing that the gas profits are raised by the consumption of gas in various places within the municipal borough of Manchester, the corporation felt, and the township of Manchester felt, it was only a fair arrangement to allow those townships to participate, though not legally entitled to do so, in the benefit of the expenditure of the gas profits; and for years past one moiety of the gas profits has been divided between those townships, and the other moiety taken by Manchester as the owners of the works; now, the result of that bill, or the powers which I believe we shall get, will be, that that moiety for ten years will go in reduction of the compulsory water-rates, if the council should think that the amount of those rates justified that appropriation.

Cross-examined by Mr. TALBOT for the Water Companies.

716. Out of what funds were the gas works constructed?—The gas works were constructed out of the public funds; in fact, out of the rates raised within the township of Manchester only.

717. In the nature of an improvement, rather than a borough rate?—It was included in the police-rate.

718. Was there a debt contracted for the erection of gas works?—There was.

719. To what amount?—The power to borrow was limited to £100,000. I may say that much more than that has been expended in gas works; I suppose double or treble that; I cannot say the amount exactly; it is a very much larger sum than that £100,000.

720. Perhaps as much as £400,000?—No, not so much as that; it is upwards of £200,000; perhaps about £250,000.

721. Where did the other £150,000 come from?—It has come out of the profits.

722. The original and subsequent outlay upon the gas may be divided into money borrowed partly upon the security of the police-rates, to the amount of £100,000, and the other £150,000 out of gas profits?—It is very likely that that is so; it is, in fact, out of gas profits, because by the act we are bound to create a sinking fund of £5000, but there is a power to re-borrow from time to time as it may be required. We have created that sinking fund for many years; and in addition to that they have expended out of the profits, which according to the strict letter of the act they had no right to do, upwards of £50,000, because the demands for gas led to extensions, which were carried out, and, that being the only fund, they were paid for out of the accruing profits.

723. Do you mean that in the time of the corporation you have gone on laying out profits and capitalizing them?—It was chiefly before the corporation had the transfer to them; the same thing has occurred to a limited extent, I have no doubt, during the management of the corporation.

724. There is a subsisting debt of £100,000 upon the gas concern, is there?—Yes, it is about that.

725. Which you have never attempted to reduce?—It has been repaid and borrowed again; I ought to state that there is a subsequent debt of £100,000 and odd, but not for the purposes of gas works at all; it is authorized to be borrowed by Parliament, for the purpose of carrying out improvements, the fact being, that we can anticipate by that means our annual profits, which were applicable to carrying out the improvements.

726. Which, had not you levied in that way upon gas profits, you would have levied, as other towns do, by an improvement rate?—If we could have got the power, which I do not think we could, that would have been the only source open to us if we had not these gas works.

727. You do not think you could have raised the rate?—I do not think the town council could have obtained power to raise the rate.

728. Is the consumption of gas coextensive with the consumption of water, do you think?—Certainly not.

729. It is not so at present?—At the present time there is no doubt that gas is consumed to a greater extent than water; that is to say, it was so under the old arrangement; I should say that gas was consumed more extensively than water under the old system, when people would take gas or leave it as they liked.

730. Under the compulsory principle, when everybody is to take the water, do you suppose everybody who takes the water will burn gas?—No.

731. What do you suppose will be the proportion of gas consumers in Manchester to the whole population; 20 per cent.?—I cannot give an opinion; it is more than that I should say; I believe gas is consumed very extensively; but the gas consumers are not the whole inhabitants.

732. This much is clear, is not it, that upon this system of water supply the man who burns gas is paying for his neighbour's water?—There is no doubt he is contributing towards it.

733. But he is backed at the same time in your system, not only with gas, but, behind that again, with a mortgage to the extent of £100,000 upon the police-rates?—I do not understand you.

734. Did not you tell me that the gas works had been constructed upon money borrowed, to the extent of £100,000, upon the security of the police-rates?—Yes, that is a part of it.

735. Does the gas pay the interest upon that debt?—It does, before the profits are ascertained; it is like any other trading company.

736. A trading company has this unpleasant predicament, of finding its own capital before it begins?—This is as much a trading company as any other; the inhabitants of Manchester are the owners of these works.

737. Did the inhabitants of Manchester contribute to the construction of the works?—They did.

738. In what way?—They found the money by paying rates.

739. To the extent of £100,000 out of £300,000?—To the extent, probably, of more; I cannot say how much.

740. So far as the £150,000 debt, which, plus the original £100,000, has been repaid upon the security of the gas returns, is not it true that the gas consumers only in Manchester found that capital?—There is no doubt of it; I have no doubt it is true to that extent.

741. You say, however, that in the meantime you have had gas cheaper than other places have?—Yes.

742. Do you mean to say that the gas supplied by the corporation in the way in which it has been described to be supplied at Manchester has been as cheap as it has been in Liverpool, supplied by private trading companies?—I believe it has.

743. You can have no hesitation, therefore, in letting me see the gas accounts which are published at Manchester?—You shall have a copy of the corporation accounts, if you like.

744. Your price is from 4s. 6d. to 5s.?—It is from 4s. to 5s.; I have sent for a statement of the prices; I speak with certainty that the highest price is 5s., no matter how small the quantity; the lowest is either 4s. or something less; I believe a change was made a short time ago which reduces it below that; the price in no instance exceeds 5s., and, I believe, goes down to 4s.

745. You will be good enough to let me see the corporation accounts with respect to the manufacture and distribution of gas, will you?—You shall have a copy of the corporation accounts.

746. Will those gas accounts show where the funds came from for erecting the gas works?—I do not believe they will.

747. But they will show me, I presume, at what price the gas has been sold and distributed to private consumers and to public lamps?—No, they will not show that; that information I shall obtain. I believe the accounts will not give you the slightest particle of information; it is a mere debtor and creditor account.

748. Does Manchester carry on gas-making upon that footing?—There is not a gas paper issued which has not upon the back of it the price of gas for all quantities, but that is not in the summary of accounts. The account of receipts and expenditure has nothing whatever to do with the details of the price they charge per 1000 feet.

749. You will give us those details?—I will.

750. You are so near Liverpool that I am almost tempted to repeat the question, whether you do not know that the price at Liverpool, by trading companies who have to make a living out of it, is less than at Manchester?—I believe it is not.

751. Do you make gas from the same coal as the Liverpool people do?—I cannot tell; I should think probably we do. We go to Wigan, which is about halfway.

752. That is the Wigan cannel coal?—Yes.

753. Which is an admirable gas coal, is not it?—It is a very good gas coal.

754. Favourably situated, doubtless, you are with respect to coal, are not you, in point of neighbourhood and in point of quality?—I should think so.

755. Do you know that the price of gas in London is 4s. per 1000 feet?—I believe it has been reduced to 4s.; it is a short time ago.

756. Is there the least doubt about this, that, but for the subsidizing of water by gas, gas might have been supplied to Manchester very much cheaper than it is now?—No doubt it might; but it would have been most unjust if it were so. I can give very good reasons for it.

757. What is the price of coal at Manchester?—I do not know.

758. You do not attend to gas matters at all?—Certainly not.

759. You do not know what you pay for your own, do you?—Unfortunately I do not require any.

760. Have you had any differences in the council of Manchester about the policy of this system of supplying water and gas?—None whatever.

761. They are all of a mind, are they?—I believe it is the case, not only in the council, but throughout the whole borough.

Re-examined by Mr. JAMES for the promoters of the Government Bill.

833. The corporation has had the management of the gas?—Yes.

834. Have there been any complaints to any extent of the management and distribution of gas by the corporation?—Certainly not; a short time ago the price of gas in Manchester being higher in some respects than the price in Liverpool, where there was at the time a most active and strong competition, and a competing scheme also before Parliament, the price was voluntarily reduced by the corporation to an extent which sacrificed at once an income of £15,000 a year; but for years we have had no application on the part of the inhabitants, the gaspayers, for any reduction.

835. To your knowledge has there been a single petition addressed to the corporation on the subject of the reduction of the price of gas?—No, not for years.

JUNE 30TH.

Further examined by Mr. MELLOR.

1749. Can you now state what prices are at present charged for gas in Manchester?—I have received from Manchester a statement of the prices charged for gas, and I find I was correct in stating that 4s. per 1000 cubic feet is the lowest price at present, and 5s. per 1000 cubic feet the highest. The scale begins where the annual consumption is under 200,000 cubic feet, the price being 5s. per 1000 cubic feet. Where it amounts to 200,000 cubic feet, and is under 400,000, there is a discount allowed of 2½ per cent. If the annual consumption is under 600,000, the discount allowed is 5 per cent. If under 800,000 cubic feet, there is a discount of 7½ per cent. If under 1,200,000 cubic feet, there is a discount of 10 per cent. If the consumption is under 2,000,000, there is a discount allowed of 12½ per cent. If under 3,000,000, there is a discount of 15 per cent. Where it is under 5,000,000, a discount is allowed of 17½ per cent.; and where it amounts to 5,000,000 and upwards, the discount is 20 per cent. I find that for street lamps there are two charges made. What are called flat-flame burners, burning for 3500 hours during the year, are charged £2 per annum; single-jet burners, burning 3500 hours, £1. 2s. per annum.

1750. Is there any specified quantity to be burnt in those lamps?—I believe not.

1751. No illuminating power is specified?—No; the illuminating power has been tried, and is as good as the illuminating power in the metropolis. The above charges are for gas only, exclusive of lighting and repairs and cleaning.

1752. Lighting and cleaning and repairing is an extra charge beyond the prices which you have specified?—Yes; the lighting is undertaken by a different body, the repairs are undertaken by the gas committee, I believe at 2s. 6d. a lamp per annum, that includes all repairs.

1753. No portion of the lighting or cleaning or repairing is included in the prices you have stated?—No, not in the £2, or the £1. 2s.

1754. Mr. Sergeant WRANGHAM.] You have given us the prices depending upon the quantity taken by each consumer, can you state the average price actually charged; taking the whole quantity of gas sold, what is the amount which is actually received?—I believe the gross amount of the gas rentals will be something like £80,000 or £90,000 per annum.

1755. And the gross quantity of gas consumed?—That I cannot say.

1756. By the COMMITTEE.] Can you obtain that information?—I think it is very likely that I might be able to do so.

1757. Mr. Sergeant WRANGHAM.] Can you tell us whether the body superintending the supply of gas at Manchester have extraordinary remedies for the recovery of arrears?—No, they have no extraordinary remedies; they have made certain regulations; they are carrying on business like any other gas company; I have no doubt the regulation to which the learned counsel refers is this: it has created some degree of dissatisfaction, and the consequence of that dissatisfaction operating upon the town council has been, that the practice is now about being discontinued; the practice was this, that they would not light houses where there was an arrear of gas rent left by the preceding tenant: there was no legal power whatever to enforce such a regulation; the inhabitants were considered to be the owners of the works interested in the profit, and therefore it was really for their own benefit that this regulation was made, but it has been found objectionable; those objections have been brought forward in the town council, and the effect has been that, though I believe at the present time it is not absolutely discontinued, yet it will be.

1758. It is under that system that those prices have been maintained?—That has had nothing to do with the prices, I believe.

1759. It is in connection with that mode of compelling the payment that the prices you have given us have been charged?—Much higher prices had existed under that system.

1760. By the COMMITTEE.] Can you tell the committee what kind of coal it is you use?—I believe the cannel coal, which has been used chiefly, comes from the neighbourhood of Wigan; it comes from various mines.

1761. Do you know the price of coal at Manchester?—It varied, according to the last proposals, from 10s. or 11s. to 14s. or 15s. a ton; there was that difference in the tenders which were recently sent in.

JULY 3RD.

2953. By the COMMITTEE.] Have you the further information respecting the supply of gas to Manchester which you were requested to furnish?—I was requested to obtain the quantity of gas which had been sold during the year 1850, and the total receipt for gas; the total quantity of gas consumed was 401,541,000 cubic feet for the year ending June 24th, 1850; the gross amount of rental, including the amounts paid for street lamps during the same period, was £86,538. 2s. 8d.; the rates charged I have already stated during that year, and I find that the prices charged for the seven years preceding were as follows: in 1850 the highest price per thousand cubic feet was 5s., the lowest was 4s.; in 1849 the highest price was 5s., the lowest 4s. 6d.; in 1848 the highest price was 5s., the lowest 4s. 6d.; in 1847 the highest price was 6s., the lowest 5s.; in 1846 the highest price was 6s., the lowest 5s.; in 1845 and 1844 the prices were the same; I was also requested to obtain copies of the accounts as published for four years; I now lay before the committee the accounts as published by the gas committee for the years 1847, 1848, 1849, and 1850. [*The same were delivered in.*]*

2954. Mr. TALBOT.] Are those all the accounts which are to be had?—They are all that I asked for.

2955. They are not all that I asked for?—They are all I am in a situation to produce.

2956. Are there no earlier ones existing?—Every year there is something like an account published in the newspaper, but it is only for the last four years that the proceedings of the council have been regularly published and sent round to all the members; therefore it is only by reference to the newspaper, or copying them from the books, that you could have an account for the previous periods; they are obtainable of course, if it is thought worth while; I have not given any instructions to have them copied, nor did I presume that it was intended.

2957. My learned friend, Mr. Sergeant Wrangham, was anxious to obtain from you the average price upon the whole quantity sold?—I am laying before the committee all the information I was asked to obtain; I was told if I would get the total quantity of gas sold in the year 1850, and the total amount received, it would be sufficient.

2958. Do you decline to produce the accounts from the beginning of this gas proceeding of the corporation of Manchester?—I do not decline to produce anything which I am required to produce, but I cannot be here again; I am leaving town to-day or to-morrow.

2959. When did the accounts begin?—The gas works were estab-

* Copies of these accounts for 1848, 1849, and 1850, will be found in the Journal for February last.

lished in 1828, I believe; it is quite out of the question for us to furnish all the accounts, unless we are to employ a clerk to do the work to copy them; if the learned counsel thinks it worth while, it will not, I dare say, be objected to if the expense be paid.

2960. Have not you two or three prices?—I have given the prices in detail; the maximum and minimum have been slightly changed in previous years, but the same discount I have no doubt has remained; if the learned counsel really wishes anything else, I have no doubt that we shall be able to supply it from Manchester.

JULY 23RD.

Mr. *Alfred King* examined by Mr. Sergeant BELLASIS for the Water Companies.

9581. Are you the engineer to the Liverpool Gas Company?—I am.

9582. That is a joint-stock company?—It is.

9583. Have you read Mr. Heron's statement, in his evidence, that gas is furnished to the gas consumers at Manchester at a price unreasonably low, and which they have no right to expect gas at?—I have.

9584. Is the gas at Manchester to be made of the same coal as the gas at Liverpool is made of?—Professedly so.

9585. Is that the best coal which is to be got for that purpose?—In that district.

9586. Cannel coal?—Yes.

9587. You make your gas at Liverpool of cannel coal?—Yes.

9588. And you understand they do so at Manchester?—I believe so.

9589. At all events, they may?—Yes.

9590. Is the coal-field from which the cannel coal comes as near to Manchester as it is to Liverpool?—Rather nearer, I think.

9591. It is the Wigan coal, I believe?—Yes.

9592. Is the gas at Manchester supplied lower than it is at Liverpool?—No, it is higher.

9593. Manchester being in the hands of the corporation, and Liverpool in the hands of a joint-stock company?—Yes.

9594. What is the gas supplied at at Liverpool?—Four shillings and sixpence per 1000 feet to all consumers.

9595. Have you seen the table put in by Mr. Heron, in which he gives the rates charged for gas at Manchester?—No.

9596. You know what the rate is?—Yes.

9597. Is the charge at Manchester 5*s.* per 1000 cubic feet for all quantities under 200,000 feet?—Yes.

9598. The charge is 5*s.* per 1000 cubic feet for all gas supplied under £50 a year?—Yes; 200,000 at 5*s.* being £50 a year.

9599. All the gas consumers under £50 a year pay 5*s.* per 1000 cubic feet?—Yes.

9600. All that class of persons at Liverpool pay 4s. 6d.?—Yes.

9601. What proportion of the consumers at Liverpool pay more than £50 a year?—There are above 23,000 tenants.

9602. How many of those pay above £50 a year?—Seventy-seven or eighty.

9603. Therefore, at Manchester it would be the vast majority of consumers who would pay the high price of 5*s.*?—Yes; the Manchester scale being applied to Liverpool, there would be only eighty persons entitled to have any reduction upon the maximum rate.

9604. Of 5*s.*?—Of 5*s.*

9605. For quantities over 200,000 cubic feet at Manchester I believe a discount is allowed?—Yes.

9606. Do you know what that discount is?—I have a table here which shows that. If the quantity consumed exceeds 200,000 cubic feet, and does not exceed 400,000, there is a discount of 2½ per cent. allowed.

9607. Therefore persons taking less than 400,000 cubic feet of gas get it at 4s. 10½d.?—Yes.

9608. That is 1½d. per 1000 feet less?—Yes.

9609. Above 400,000 and up to 600,000, what discount is allowed at Manchester?—Five per cent.; the net price would be 4s. 9d.

9610. From 600,000 to 800,000 the discount is 7½ per cent.?—Yes.

9611. The net price is 4s. 7½d.?—Yes.

9612. From 800,000 to 1,200,000 the discount is 10 per cent.?—Yes, the net price being 4s. 6d.

9613. In order to get gas at Manchester as cheap as you have it at Liverpool, the consumers must consume above 800,000 cubic feet?—Yes.

9614. Is that equal to £200 a year?—Yes.

Cross-examined by Mr. MELLOR.

9615. Have you printed tables of the prices you charge at Liverpool?—No; our price being 4s. 6d. there is no occasion for it.

9616. Is your maximum 5*s.*?—Our maximum is 4s. 6d.

9617. What is your minimum price?—Four shillings and sixpence.

9618. You have one uniform price, have you?—Yes.

9619. At Manchester, as I understand, they have not a uniform price, but a maximum and minimum price?—Yes.

9620. The maximum is 5*s.* and the minimum 4s.?—Yes.

9621. Mr. Heron says the highest price is 5*s.* and the lowest is 4s., is that correct?—Yes, but they must burn 5,000,000 cubic feet of gas in order to be entitled to the reduced price of that amount.

Cross-examined by Mr. VAUGHAN.

9622. How long has the price of gas at Liverpool been at 4s. 6d.?—For three or four years.

9623. Do you supply all your customers in Liverpool by meter, or do you make contracts?—All by meter; at least the exceptions are so few that they are hardly worth notice.

9624. There are some exceptions?—Many years ago the majority of the consumers were supplied by contracts; the system of meter was adopted, I think, in the year 1836; since then no new consumer has been supplied except by meter; and the few contract tenants that remain are only those who came under the former arrangement; there may be ten or twenty.

9625. Do you know what the relative quantities of gas are which are consumed in Liverpool and in Manchester?—I should think, in Liverpool, the quantity is about 530,000,000 per annum; in Manchester, including Salford, I do not think it is quite so much as that. By the last report I saw as to Manchester, their quantity was 400,000,000. Then the consumption of Salford is from 50,000,000 to 70,000,000.

9626. By the COMMITTEE.] At what rate do you supply the public lamps?—The public lamps are charged £4. 2s. 6d. per annum, but that includes the expense of lighting and extinguishing, cleaning and repairs.

9627. Are they any peculiar lamps?—They are bat-wing burners.

9628. Mr. VAUGHAN.] Do you know that in Manchester the large consumers of gas are much more numerous than they are at Liverpool?—I should think they were in a larger proportion certainly.

9629. A very much larger proportion, are not they?—I should think so; but the number of shopkeepers in Manchester, I should think, would not be greater than in Liverpool.

9630. By the COMMITTEE.] You have had great experience in gas manufacturing?—I have had some experience.

9631. The quantities consumed in Manchester and Liverpool are so near as not to lead to much difference in that respect?—Yes.

9632. The price of making gas depends of course considerably upon the quantity made?—Yes.

9633. You are aware that a great deal depends upon the quality and the price of coal?—Yes.

9634. Manchester is remarkably well situated in respect to its coal?—Yes.

9635. There is coal of the very best quality contiguous to Manchester?—Yes.

9636. Is it your opinion that, taking into account the quantity of gas consumed at Manchester, and the advantages they have with respect to the price and the quality of the coal, the price of gas is high or low at Manchester?—It is high; compared with Liverpool it is high.

9637. Do you know any town anywhere, taking into account all the circumstances of the case, where the price of gas is higher than it is at Manchester?—I would not venture to say that.

9638. Any town of that magnitude?—It is a question which I am hardly prepared to answer. I am prepared at once to say, that I think, under the circumstances, the price of gas at Manchester is high, because they have had every advantage of making cheap gas there; their mains do not extend very far into unprofitable districts, they have only one set of mains, and they have every facility for getting coal rather cheaper, I think, than at Liverpool; the carriage of coal to Manchester, I think, is less than to Liverpool; so that, under all circumstances, I consider the price of gas at Manchester is high, but, whether it is higher than in any other town, all circumstances being taken into account, I am hardly prepared to say.

9639. Is the cost of producing gas of equal quality higher or lower at Liverpool as compared to Manchester?—I should think the cost would be rather higher at Liverpool; I am not very familiar with the accounts, but I think our rates come to £4000 a year in Liverpool.

9640. Is the whole of the gas for Manchester and Salford manufactured at one place?—No, they are two separate companies.

9641. Do you know what their works are rated at?—No.

9642. Your own is rated at £4000?—I think the rates we pay are about £4000 a year.

9643. Do you know that the Manchester works are not rated at all?—No.

9644. Though you pay £4000 a year, and use the same raw material, you retail the article manufactured at a lower price?—We do.

9645. Mr. VAUGHAN.] I understand that the manufacture of gas in Salford is in the hands of a company distinct from the manufacture of gas in Manchester?—Yes.

9646. What is the quantity of gas manufactured in Manchester for Manchester alone?—I believe about 400,000,000; but I do not speak with any great certainty as to the correctness of that answer.

9647. Mr. MELLOR (through the COMMITTEE.)] There were formerly two companies at Liverpool which were amalgamated; can you tell the committee whether the public have received any advantages from that amalgamation in preference to the introduction of a third company; has there been any reduction of the rate?—There has been no alteration of the price since the amalgamation; the prices were the same by both companies before they were amalgamated.

9648. When was your last reduction?—I think four years ago.

9649. By the COMMITTEE.] What has been the highest amount of rate which you have levied?—As much as 12*s.*; I am not sure whether it has not been as high as 15*s.*

9650. It has come down from 12*s.* or 15*s.* to 4*s.* 6*d.* in your memory?—Yes.

9651. Was it under competition it was first reduced?—No; I think the first reduction was before there was a competing company, but I think from about 12*s.* to 4*s.* 6*d.* it has been reduced by the effect of competition.

9652. When did the competition cease?—In 1848.

9653. And the reduction of price ceased also with competition, did it?—There has been no reduction since; but I think it is fair that I should be allowed to state, that the company has never made its maximum amount of profit since the price was reduced to 4*s.* 6*d.*; the profits under the act are limited, and the price is limited under the act.

9654. What is the limited price under the act?—Four shillings and sixpence.

9655. Then you are at your maximum?—Yes.

9656. When was the price so fixed; was it when the combination took place in 1848?—No, before then; it is about four years ago, I think.

9657. Was there an act consolidating the two companies?—There was.

9658. The price to which the cost had been reduced under competition was fixed as the maximum under the act?—It was.

9659. Are the dividends regulated by the act?—They cannot exceed £10 a share.

9660. Are you at your maximum dividend?—Nearly, if not quite; I think the dividend was £9. 15s. last year.

9661. When you touch your maximum, what does your act provide?—That the price shall be reduced; but it first provides that a reserve fund shall be accumulated to the amount of 3 per cent. upon the capital subscribed.

9662. Are they £100 shares?—Yes.

9663. Did you ever know a parliamentary maximum touched either in a gas company or any other?—No, there are very few bills which have a maximum fixed; I do not know of any other town which has been so restricted under its acts as Liverpool; the new capital, I should say, is raised in quarter shares of £25 each, and all the new capital is raised by sale by auction.

9664. I suppose there is a provision made that when the maximum of 10 per cent. shall have been touched, and the reserve fund realized, then in remote prospect there is to be a reduction of the rate?—There is to be a reduction.

JULY 24TH.

9665. Have you a table of the Manchester discounts which you spoke to on your examination yesterday?—Yes.

9666. Will you put it in?—

[The same was delivered in, and is as follows:]

CUBIC FEET.	Rate per 1000 feet.	Discount per Cent.	Reduced Rate per1000.	Gross Amount of Rate per Annum.	Amount of Discount.	Reduced Amount of Rate per Annum.
	s. d.		s. d.	£. s. d.	£. s. d.	£. s. d.
Under 200,000	5 0	none	—	—	—	—
„ 200,000	5 0	2½	4 10½	50 0 0	1 5 0	48 15 0
„ 400,000	5 0	5	4 9	100 0 0	5 0 0	95 0 0
„ 600,000	5 0	7½	4 7½	150 0 0	11 5 0	138 15 0
„ 800,000	5 0	10	4 6	200 0 0	20 0 0	180 0 0
„ 1,200,000	5 0	12½	4 4½	300 0 0	37 10 0	262 10 0
„ 2,000,000	5 0	15	4 3	500 0 0	75 0 0	425 0 0
„ 3,000,000	5 0	17½	4 1½	750 0 0	135 5 0	618 15 0
„ 5,000,000	5 0	20	4 0	1250 0 0	250 0 0	1000 0 0

9667. That table which you have put in does not show the relative number of persons who are entitled to reduction under the Manchester system?—No; it merely shows the effects of the sliding scale of discount.

9668. You spoke yesterday of there being a greater number of large consumers at Manchester than there were at Liverpool; when you spoke of large consumers, what did you mean?—All manufacturers and mill-owners, not as affecting the community generally.

9669. Is it not the fact that at both places, both at Manchester and at Liverpool, the great body of the consumers are shopkeepers and persons of that class?—Yes.

9670. Small manufacturers, publicans, and domestic consumers?—Yes.

9671. The great bulk of the gas consumers are of those classes?—Yes, certainly.

9672. All those people of whom you speak as being the great bulk of the consumers at Manchester pay 5s. a thousand cubic feet?—Yes.

9673. And at Liverpool the same class of persons pay 4s. 6d.?—Yes.

9674. You said that, in your judgment, the price at Manchester is a high price?—I think so.

9675. Too high?—I think so.

9676. You were not able to state yesterday whether or not the township rates are chargeable upon the gas at Liverpool?—They are chargeable at Liverpool.

9677. Can you state what the amount of those rates is?—Last year the amount was £4500. The item of rates and taxes in our account amounted to £4500.

9678. Are those rates and charges upon the gas at Liverpool rates and charges which are not payable upon the gas at Manchester?—That I cannot say.

9679. You do not know?—I do not know.

9680. At all events, £4500 which is payable at Liverpool is equivalent to about 2d. per 1000 feet?—It is fully that.

9681. Assuming that those rates are not paid upon the gas at Manchester, the price of gas at Manchester and the price of gas at Liverpool stand as 5s. to 4s. 4d.?—Yes.

9682. To the great body of consumers?—Yes.

9683. My learned friend, in cross-examining you, obtained from you the fact that at Liverpool there used to be two companies, and that they were combined into one?—Yes.

9684. Have those two companies pipes running side by side throughout Liverpool, or the greater part of it?—Yes, throughout all the principal streets; the great majority of all the streets, I think.

9685. Are there many miles of pipes running in the same streets?—I should think as much as 100 miles belonging to each company, or 200 miles of parallel mains.

9686. Do they still exist?—Yes; the greater proportion of them do.

9687. So far as there are duplicate mains existing in the streets of Liverpool, is that a disadvantage in the distribution of gas, as compared with Manchester?—Certainly.

9688. By the COMMITTEE.] Do they all run down the line, or have they each a separate bed of their own?—In some streets the population is all on one side of the street, and there the mains of both companies were laid, as being more convenient; there is no general rule as to that.

9689. Mr. Sergeant BELLASIS.] Of course there is more pipeage where there are two sets of pipes than where there is only one?—Yes.

9690. Is leakage an important matter in the supply of gas?—Yes.

9691. In the cost of production, of course?—Yes.

9692. Yesterday you stated, in answer to question 9647, that there had been no alteration of price since the amalgamation?—No.

9693. But there had been shortly before a reduction to a very low rate, had not there?—Yes, there had.

9694. Was that during the existence of any competition?—There were two companies; but there was no competition, virtually.

9695. There was no competition for price between them?—No, certainly not.

9696. But there was a reduction by both companies to the present price shortly before their combination?—Yes; before the combination there was.

9697. That is, down to 4s. 6d.?—Yes.

9698. Was that reduction in some degree anticipatory of the additional use of gas in the town?—Yes; certainly, the former reductions were; the price under the second act of the company was limited to 7s.; to be reduced when the profits of the company were fully realized; there was first a reduction under the operation of the act from 7s. to 6s. per 1000 feet, and, subsequently, to 5s. per 1000 feet.

9699. The right honourable chairman asked you yesterday whether you ever knew a parliamentary maximum touched either by a gas company, or by any other company?—Yes, my answer was incorrect; it has been touched; it was touched in our own case.

9700. In the year 1844 at what price was the Liverpool company selling gas?—Seven shillings.

9701. That was your maximum?—Yes.

9702. You reached your maximum dividend, did not you?—Yes.

9703. And you had completed your reserve fund?—We had.

9704. And, therefore, you reduced your rates?—We reduced our rates.

9705. To 6s.?—Yes.

9706. Did the same process again take place when you reduced the price to 5s.?—I believe it was so, or it was supposed that we should soon arrive at that point; it was anticipated, and reduced accordingly.

9707. Therefore, that unusual event did happen in your company, that you reached your maximum dividend, and filled up your reserve fund?—Yes.

9708. And you reduced your rates accordingly?—Yes.

9709. By your act the company is obliged to file its accounts with the clerk of the peace, is it not?—Yes.

9710. And they are regularly audited by him, I believe?—They are audited by officers of the company appointed under the act, but they are also audited by a public accountant appointed by the recorder, who reports to him the state of the accounts.

9711. He not only comes to see your accounts, but he makes a special report to the recorder upon them?—He does.

9712. Has the recorder any power to compel you to reduce your rates?—Yes.

9713. And, in fact, your accounts are all exposed to the auditor?—Yes.

9714. Have you ever been in a position to be obliged to be called in by the recorder to reduce?—No; we have always anticipated the call for reduction.

9715. What does the price paid for the public lamps, which you mentioned yesterday, include?—It includes all expenses connected with the maintenance of the lamps, the lighting, cleaning, and extinguishing.

9716. Does that include every night in the year?—Yes, 365 nights in the year, and 3620 hours.

9717. You are bound to light every lamp within the borough, whether your pipes are there or not, are not you?—Yes, we must lay down pipes if they are not there already; if the lighting committee of the corporation think fit to erect lamps in any part of the parliamentary borough, there we are bound to take our pipes.

9718. By the COMMITTEE.] What do you estimate to be the cost of maintaining, and cleaning, and lighting the public lamps?—About 22s. per annum; so far as my own observation has gone, the burner used at Manchester is a smaller burner than that which is used at Liverpool.

9719. Can you tell us how many feet per hour your public lamp burns, and how many hours the public lamp at Manchester burns, taking it to have the same illuminating power?—That involves the question in this way: our burners burn four cubic feet per hour; I should presume the Manchester burners would burn three cubic feet.

9720. Why do you judge so?—I do not wish to attach much importance to the answer; it is a mere guess.

9721. Mr. Sergeant BELLASIS.] It is easily ascertained, I suppose?—Yes.

9722. Looking at it with a gas eye, you think you see a difference?—Yes.

9723. There were, in fact, as you have already told us, mains belonging to the two companies running side by side, and competing, at Liverpool?—Yes.

9724. If the two companies had had distinct and separate districts in Liverpool, would there, in your judgment, have been any advantage in combining them?—No, I think not.

9725. Would there have been any saving in the management as respects the number of clerks, and so on?—No, not if districts had been assigned to each company.

9726. In Liverpool districts were not assigned to each company?—No.

9727. As to the necessary supervision, do you think a district may be too large for supervision under one control?—Yes, I think so.

9728. Mr. JAMES.] You say that at one period the maximum has been touched?—Yes.

9729. That is to say, you collected the maximum rate charged from the public?—Yes.

9730. What was the date of that?—I think it was in the year 1845, and two or three years prior to 1845.

9731. You touched the maximum rate, and the proprietors touched the maximum dividend?—Yes.

9732. But, before you touched the maximum dividend, you had, out of that maximum rate collected from the public, laid by or procured a reserve fund?—Yes.

9733. To what amount?—I think it was £6000.

9734. Then you had a fund of £6000 collected from the public, and you divided the maximum dividend?—Yes, we arrived at that state of things in 1845.

9735. What dividend did you divide?—£10 per £100 share.

9736. Do you mean that you laid by the reserved fund upon one year's collection?—No; it would be the accumulation of several years.

9737. How long did the maximum rate exist?—Three or four years.

9738. To what amount did you reduce the price?—To 6s.

9739. Then, when you want a reserved fund again, I presume the same course will be resorted to?—Yes, when we want a reserved fund again.

9740. How often will that occur?—That depends upon circumstances.

9741. It is entirely optional with you, I suppose?—It depends upon the circumstances of the company.

9742. You have no supervision of any kind; your accounts are audited; but it is optional with you, when you may choose, to put the maximum rate upon the public, and lay by a reserved fund, is not it?—I do not consider it optional.

9743. When, in your judgment, you want a reserved fund, you do not lay by that reserved fund out of your ordinary dividend, but you put your maximum rate upon the consumers, and so lay by your reserved fund?—Yes.

9744. Out of your ordinary dividend, and your ordinary rate, you do not annually lay by any reserved fund?—No.

9745. But the system would be to create that reserved fund from the maximum rate upon the consumers, which, I presume, would produce you a reserved fund, and also, contemporaneously, a dividend of 10 per cent.?—Not necessarily 10 per cent.; it is certainly obtained from the maximum rate. If it were not for the purpose of creating a reserved fund, there would be no reason for charging the maximum rate.

9746. How often do you want a reserved fund?—The object of a reserved fund is to supply any defects that there may be in the amount of the dividend, owing to the deficiency in the year's earning; it is a fund provided for under the Gas Companies' Clauses Act.

9747. It is a fund reserved for the purpose of dividend?—Or for any public emergency.

9748. Parliamentary expenses?—I am not prepared to say whether parliamentary expenses would or would not come out of the reserved fund; I should think they would come out of the general expenses.

9749. Your reserved fund is for the contingency of a deficiency of dividend, and what else?—I forget exactly the words of the act; but, supposing any serious accident occurred, it would go to meet that.

9750. That is not created from your ordinary rate, but created by a maximum rate, touched in one instance, and charged upon the consumers?—The operation of the act is this: we charge a maximum rate; then it is supposed that we are enabled to pay £10 per share, and that there will still be a surplus; that surplus is placed in the reserved fund; those surpluses continue to accumulate till the maximum dividend is obtained; then the price is reduced.

9751. Since 1845, when you created your reserved fund by the imposition of a maximum rate, have you periodically and annually added to that reserved fund, or, when you want another reserved fund, will you create it by resorting to a maximum rate?—I do not understand your question, nor what you mean by "when you want a reserved fund;" if the reserved fund is one created, and is not required, we keep it.

9752. Is it in existence now?—No, it is spent now.

9753. When shall you want another?—We want it now.

9754. Then perhaps you mean to touch the maximum rate again shortly, as you want a reserved fund?—I hope to do so.

9755. When do you hope to touch the maximum rate again?—We are approaching the maximum dividend, and I hope the time is not far distant when we shall again create a reserved fund, and be able to reduce the price to the inhabitants.

9756. Before you reduce the price you will touch the maximum. When do you contemplate that that will be?—I cannot say.

9757. By the COMMITTEE.] I suppose you will keep your dividend pretty steadily at £9. 15s.?—I hope to exceed that; supposing our profits are sufficient to pay £10 per share, and there is a surplus of £1000, that £1000 is placed in the reserved fund, and so from year to year, if we are still able to pay £10 a share, with a surplus of £1000, that £1000 year by year will be added to the reserved fund, till the maximum dividend is attained.

9758. The reserved fund stood at £6000 in the year 1845?—Yes.

9759. How did you spend that?—It was spent in consequence of the reduction to 4s. 6d.; it did not afford to the proprietors a dividend of £10 a share. The deficiency was made up out of the reserved fund, till the reserved fund was expended.

9760. You applied the reserved fund in aid of the dividend?—Yes.

9761. You exhausted the whole of it in maintaining the dividend?—We did.

9762. How long were you in performing the operation of exhausting it?—About three years.

9763.—The reserved fund for three years consecutively was brought in aid of the dividend, after you had reduced the price to the consumers?—Yes.

9764. Till you exhausted it?—Yes.

9765. And now under the act you may repeat the operation?—We may.

9766. You may create a new reserved fund, keeping up the rate to the consumers, and upholding the dividend even within half-a-crown of 10 per cent.?—Yes.

9767. Mr. VAUGHAN (through the COMMITTEE.)] What is the amount of the aggregate profits divided yearly?—The amount is about £40,000.

9768. How much did you take in aid of the dividend from the reserved fund annually?—The £6000 was not equally divided; it was distributed over three years.

9769. Supposing it were equally distributed, you would have taken £2000 a year?—Yes; when the fund was exhausted we were obliged to take what we could get.

9770. Had that operation been performed before upon any previously existing reserved fund?—No.

9771. It was the first time?—Yes.

9772. Have you begun to accumulate again?—No; inasmuch as we have not attained our maximum dividend.

9773. But it is open to you to raise the price at any time, is it not?—Four shillings and sixpence is the maximum price under the act.

9774. You are at the maximum price now?—Yes; the maximum at the time it was fixed at 4s. 6d. was the lowest which ever had been so fixed.

9775. Mr. Sergeant BELLASIS.] You cannot charge more than 4s. 6d. now, either for your dividend, or for your reserved fund?—No; if we can get our £10 a share at 4s. 6d., we are entitled to it; and if we can get our reserved fund we are entitled to it; but if we can get neither we take what we can get.

9776. By the COMMITTEE.] If 4s. 6d. will yield you £9. 17s. 6d. dividend, with a surplus of £2000 a year, you may go on charging 4s. 6d. till that reserved fund reaches the maximum prescribed by the act of Parliament?—Yes.

9777. Then, having accumulated that reserved fund, you may raise the dividend 2s. more, or up to £9. 19s. 6d.?—Yes.

9778. And be still within the act?—Yes; in other words, we may have full £10 per share, and a reserved fund.

9779. And you may exhaust the reserved fund, by adding it to the dividend within the limit of 10 per cent. as often as you please?—Yes.

9780. Mr. JAMES (through the COMMITTEE.)] What is the price of a share in the market?—About £170.

9781. The original shares being £100?—Yes.

9782. Mr. Sergeant BELLASIS.] Your reserve fund by the act, I see, is to be for the purpose of keeping up your dividend to 10 per cent., and for meeting any extraordinary necessities that may come upon the company?—Yes.

9783. The 30th clause is: "The profits of the undertaking to be divided amongst the undertakers in any year shall not exceed the prescribed rate, or, where no rate is prescribed, they shall not exceed the rate of £10 in the hundred by the year on the paid-up capital in the undertaking, which in such case shall be deemed the prescribed rate, unless a larger dividend be at any time necessary to make up the deficiency of any previous dividend which shall have fallen short of the said yearly rate; if the clear profits of the undertaking in any year amount to a larger sum than is sufficient, after making up the deficiency in the dividends of any previous year as aforesaid, to make a dividend at the prescribed rate, the excess beyond the sum necessary for such purpose shall from time to time be invested in Government or other securities, and the dividends and interest arising from such securities shall also be invested in the same or like securities, in order that the same may accumulate at compound interest, until the fund so formed amounts to the prescribed sum, or, if no sum be prescribed, a sum equal to one-tenth of the nominal capital of the undertakers, which sum shall form a reserved fund, to answer any deficiency which may at any time happen in the amount of divisible profits, or to meet any extraordinary claim or demand which may at any time arise against the undertakers; and, if such fund be at any time reduced, it may thereafter be again restored to the said sum, and so from time to time as often as such reduction shall happen;" that is not a peculiar law applicable to Liverpool, but to all gas companies?—Yes.

9784. Your maximum rate is 4s. 6d., which you cannot exceed, and your maximum dividend is £10?—Yes.

Mr. *John Thomas Cooper* examined by Mr. WEBSTER for the Water Companies.

9785. Are you an analytical and practical consulting chemist?—I am.

9786. Do you reside in London?—Yes, at Blackfriars-road.

9787. Have you, for many years, had considerable experience in reference to gas?—Yes.

9788. Both in examination of its illuminating power, and other questions of purity?—Yes.

9789. I believe your attention has been very much directed to gas?—Yes.

9790. You have been in the habit of lecturing on chemistry from time to time at St. Thomas's Hospital, and other places?—In that neighbourhood in an independent school there.

9791. You say your attention has been directed for many years to the illuminating power of gas; has it been directed to it in the principal towns in Scotland and England?—Yes, all the principal towns.

9792. In 1843 had you special occasion to direct your attention to the state of gas in the principal towns?—Yes; during the time that the Glasgow Gas Bill was under the consideration of Parliament.

9793. On that occasion were you accompanied by Mr. Hawkesley?—Yes, Mr. Hawkesley and I went together.

9794. In consequence of the bill which was then pending in Parliament, had you occasion to examine the relative properties and value of the gas of the principal towns?—Yes.

9795. In the course of that tour, and with reference to that subject, did you visit both Liverpool and Manchester?—I did.

9796. Did you make a great many experiments at both those places?—At both those places.

9797. Having made a great number of experiments at both those places at that time, what was the relative quality of the Liverpool gas, as compared with the Manchester gas?—A cubic foot of the Liverpool gas, at that period, was equal to 382 candles; a cubic foot of gas at Manchester was equal to 307 candles; the relative price, comparing light for light, was as 3·82 to 3·07.

9798. That being the precise number, about what per cent. is the quality of the one better than the quality of the other?—As 1¼ to 1.

9799. The one, namely, Liverpool, was a quarter better than Manchester?—Yes.

9800. That is 25 per cent. better?—Yes.

9801. Was that the state of things in 1843 on a comparison of the Liverpool and the Manchester gas?—It was.

9802. Were there any other tests than the illuminating power applied by you?—I took their relative specific gravities, which is a test of their quality.

9803. How did they stand upon that test?—The specific gravity of the Liverpool gas was 0·559, and the specific gravity of the Manchester gas two days afterwards was 0·487.

9804. Did the specific-gravity test confirm the other test?—It did.

9805. Of course they are not similar tests?—Not similar.

9806. But one confirms the other?—Yes; inasmuch as the Liverpool is the heavier gas of the two; it is the better gas of the two.

9807. Upon both tests was the Liverpool gas found to be better than the Manchester gas?—Yes.

9808. Tested by the illuminating power, it was 25 per cent. better?—Yes; as regards the proportion of olefiant gas, that was another test.

9809. As regards that test also were the former results confirmed?—Yes; the Liverpool containing 10·57 of that gas, and the Manchester containing 8·8.

9810. Of course the thing bought its light?—Yes.

9811. And it is the illuminating power which is the test you go by?—Yes.

9812. Those other tests, I understand, are but confirmatory of that?—Yes; only to see that there was no considerable discrepancy in the results.

9813. If you found that there was any discrepancy, you would go over the experiment again?—Yes.

9814. That was in 1843; have you subsequently visited both Liverpool and Manchester?—Yes.

9815. Recently?—Yes.

9816. Did you go in consequence of the evidence given here?—Yes.

9817. What do you find to be the comparative state of the gas now on your last visit to Liverpool and Manchester?—This is the summary which I have here.

9818. As respects the illuminating power, will you compare the illuminating power of the gas at Liverpool with the illuminating power of the gas at Manchester?—I have it here differently stated, but it can be reduced to the same comparison: an Argand burner consuming four feet of Liverpool gas per hour is equal to 14·94 candles, that is nearly 15 candles; four feet per hour of Liverpool gas in an Argand burner is equal to nearly 15 candles; an Argand burner of the Manchester gas consuming the same quantity is equal to 10·58 candles: the relative proportion, therefore, is 14·94 to 10·58.

9819. That is as 15 to 10¼?—Yes; 15 to $10\frac{6}{10}$.

9820. The precise proportion of the same cubic quantity, namely, four cubic feet of Liverpool and Manchester gas, being as 15 is to $10\frac{6}{10}$, that is about 48 per cent., I believe?—Somewhere about that.

9821. So that upon that test the Liverpool gas at present is 48 per cent. better in point of illuminating power than Manchester gas?—It is.

9822. Now take the bat's-wing test?—The bat's-wing burner consuming four feet at Liverpool was equal to $18\frac{3}{10}$ candles: the bat's-wing burner consuming the same quantity at Manchester is equal to 12 candles.

9823. That gives rather a larger per centage?—Yes.

9824. As tested by the bat's-wing, it gives rather a larger per centage in favour of the Liverpool gas over Manchester?—Yes; then, taking the fish-tail burner, which is the burner which is used in the streets at Manchester, the Liverpool gas, burning three feet per hour, is equal to 13 candles, and the same at Manchester is equal to $\frac{6}{10}$ candles.

9825. Is three feet the amount burned at Manchester?—That was the nearest estimate I could come to; if we take the mean of all those results which I have done, in order to get rid of any discrepancies there may be, the mean is 46·23 at Liverpool, and 31·28 at Manchester; this reduced to the term of candles gives 15·41 at Liverpool to 10·43 at Manchester.

9826. You said just now that that was the mean; did not you mean the sum?—The sum, divided by 3, is equal to 15·41, as compared to 10·43.

9827. About what per centage is that proportion of 15·41 to 10·43?—Getting rid of the decimals, it is 15 to 10; taking in the decimals, it will be as 100 to 147.

9828. Does the result of those three experiments upon those three kinds of burners, which are the ones you have described as being the burners in common use, give as the comparison an advantage of about 48 per cent. to the Liverpool gas above the Manchester gas, as tested by the illuminating power?—Yes.

9829. By the Committee.] Fifty-two lamps at Liverpool burning Liverpool gas, an equal quantity being consumed, would give as much light as 100 lamps at Manchester?—Yes; 100 lamps at Liverpool would give nearly as much light as 150 at Manchester.

9830. Mr. Webster.] I believe the gas at Liverpool is supplied by a company?—Yes.

9831. And the gas at Manchester by the corporation?—Yes.

9832. And I believe it was so in 1843?—It was.

9833. Now, as respects the price, what is the price at Liverpool?—Mr. King has stated that.

9834. By the Committee.] The relative excellence of the gas at Liverpool, as contrasted with Manchester, has greatly improved since your last inspection?—It has.

9835. You have stated the difference at 25 per cent. in favour of Liverpool in 1843; now you put it at 43?—Yes; Liverpool remains about the same, and Manchester has depreciated.

9836. Mr. Webster.] I think, as estimated by the money test which Mr. King spoke to, namely, 4s. 6d. per 1000 cubic feet at Liverpool, and 5s. at Manchester, it is one-ninth in favour of Liverpool?—Yes.

9837. Light being the commodity purchased, the purchaser at Liverpool gets for £100 as much as the purchaser from the corporation at Manchester gets for £164?—Yes; taking the price and the quality as the test.

9838. I believe the inferiority of the gas at Manchester, as compared to the gas at Liverpool, has been matter of notoriety and comment for several years?—I have heard it stated so.

9839. It is a thing which you have often heard spoken of?—Yes.

9840. I believe they profess to make their gas from the same coal?—I do not know that they profess to use cannel coal.

9841. I believe there is a coal there called the Wigan coal?—Yes.

9842. And the Worsley coal also?—I do not know anything about the Worsley coal.

9843. Is this cannel coal, which is a good gas coal, equally accessible to both companies as respects locality?—Yes; I believe it is; I do not think there is much difference in the distance between one and the other.

9844. Has it excited your surprise that there should be this difference between the two?—No; I only know it as a matter of fact.

9845. Do you think that if any company at Manchester supplied such gas it would be taken by the public?—That would be impossible for me to answer.

Cross-examined by Mr. Vaughan.

9853. Where was it that you got the gas from which you made those experiments on at Manchester?—At one of the mills in Manchester, close to the gas works.

9854. Do you know that the gas which you made experiments on was obtained from the Manchester gas works?—I was told so by the party at the mill; they make their own gas at this mill in winter; but, not having a sufficient consumption for it in the summer season, they take it from the corporation.

9855. Mr. Sergeant Bellasis.] Was that on the last visit?—Yes; in the former visit we tried the Manchester gas in the gas works itself.

9856. Mr. Vaughan.] When was it that you made the last visit to Manchester?—About a fortnight ago or less.

9857. Do you know yourself that, at the time you made your visit to the mill in question, no gas was made upon the premises?—Yes, I am quite certain of it.

9858. Did you observe at all the condition in which the pipes were?—Yes, I did.

9859. In the mill?—Yes; we had to take out the plug from one of the cocks in order to get a supply at all.

9860. Did you observe that the pipes were in a clean state or a dirty state?—They were dirty; the plug in one of the cocks was stopped; we were obliged to take out the plug and the cock, and clean the orifice of the cock, in order to get the supply we wanted.

9861. Would not the dirty condition of the pipes considerably affect the purity of the gas?—Not at all; the gas was quite pure; it was free from all contamination by what is termed hydrogen. There was not a single trace of it either at Liverpool or Manchester.

9862. In your opinion, whether the pipes through which the gas travels are in a clean or dirty state makes no difference so far as the purity of the gas is concerned?—No, not at all.

9863. Did you make the experiments upon the gas you obtained at that mill more than once?—Yes, on two occasions.

9864. On the same day?—No, on different days.

9865. Were they two following days?—No, there was an interval of two days.

9866. Upon what quantity of gas did you make the experiment?—It is impossible to tell you what quantity I consumed; I could not give you any idea; perhaps many hundred cubic feet.

9867. Did you make experiments upon the gas at Liverpool more than once?—Not upon this occasion; I only made it once at Liverpool on the last occasion.

9868. By the Committee.] Where did you make the experiment at Liverpool?—In one of the works which is now out of work.

9869. One of the gas works?—Yes, which is not now occupied as a gas work; but they had a gasholder on the premises, and it was from that gasholder that the gas was taken for the purpose of the experiment.

9870. In fact, you got it as it was taken from the gasometer?—Close to the gasometer, and that gasometer was supplied from two works, one at one side of the town, and the other on the other; the gas was mixed in this gasholder for the purpose of supplying a particular part of the town.

9871. You have told us that you do not know what coal is made use of at Manchester?—No.

9872. Do you know what coal is generally made use of at Liverpool?—They use cannel coal there.

9873. That you do know?—Yes.

9874. Do you know that it sometimes happens at gas works that, in consequence of a want of superior coal, an inferior coal is resorted

to for the purpose of making gas for a few days?—Yes, if they cannot get the superior quality.

9875. They would then have recourse to what coal they could obtain for the purpose of making the gas?—Yes.

9876. Whether or not you happened to be at Manchester at a time when they may have been burning inferior coal, from the want of superior coal, you cannot tell?—I do not know anything about that.

9877. Did you make inquiries at all at the corporation works upon the subject?—No, I did not go near them; I took the gas as I found it.

9878. In what way was it that you ascertained the illuminating power of the gas at Manchester?—If I were to attempt to describe it probably I should not make myself understood. It is the mode ordinarily adopted for the purpose at the present day, that is, by placing a light here and a light there [*describing it*], and moving a semi-transparent disc along till the shadow is equal on both sides.

9879. By the Committee.] There is not the slightest difficulty in ascertaining it, is there?—Not at all; it only requires a little practice.

9880. It is the test constantly applied, is not it?—Yes.

9881. Mr. Vaughan.] Though there appears to be no great difficulty in regard to it, are not errors sometimes made in endeavouring to ascertain the illuminating power of gas?—No doubt there are, and that is why I have taken the mean of several results in order to get at an accurate one.

9882. You have given the mean of three experiments?—At each place; but I have a long series of experiments here from which those are deduced.

9883. I want to know whether you confined your attention to three experiments, or whether your experiments have been more numerous?—I should think the experiments from which these are deduced would amount to something like thirty or forty.

9884. You say that the mean is as 15·41 to 10·43; does that make a difference of 48 per cent. in favour of Liverpool?—Yes, if I have made no error in the calculation.

9885. Is it, in fact, more than one-third?—According to this proportion it is, unless I have made an error, and I do not think I have, because I have gone over the calculation twice, and it has been checked also by another gentleman from different data.

9886. 15·41 to 10·43 appears to me to be only a difference of a third?—I think if you will work this proportion you will find it correct.

9887. Does not it appear to you to be only a difference of one-third?—Take it the reverse way, 10·43 is to 15·41, you will find it will come out right; you put the proportion the wrong way.

9888. You did not make any experiments at any place in Manchester except the mill you have spoken of?—That was the only convenient place I could find for the purpose.

9889. By the Committee.] You say you took the gas at Manchester from a factory where the pipes were not clean?—Yes.

9890. And you took the gas at Liverpool close to the gasometer?—Yes; I should say that the distance from the gasometer in both cases was not very considerable, not many feet; the gasometer was on one side of the wall at Manchester, and I was operating on the other.

9891. You have no difficulty in telling the committee that, to the best of your judgment, it was a fair experiment in reference to the places from which you took the gas?—I am quite certain it was.

9892. And checking the contrast of the relative quality by the various tests which you have described, and finding those tests one corroborating the other, you feel certain as to the relative proportions of illuminating power?—I feel quite confident of it.

Re-examined by Mr. Webster.

9900. When you were at Manchester, did the street lamps happen to be out?—Yes, they were all out one night.

9901. My learned friend has asked you several questions about these experiments, and you have said that they were fair experiments; I think the experiments in 1843 were made in the winter time, were not they?—Yes, they were made at the beginning of the year; there was one on the 21st of March, and the 19th of March was the date of the other.

9902. This is not the first time that attention has been directed to the inferiority of the Manchester gas as compared to the Liverpool gas?—No, it is notorious.

9903. Looking back to what took place in 1843, and to the recent experiments, have you any reason to doubt about the accuracy of the two experiments, and the inferiority of the one gas to the other?—Not the least.

9904. One question about this coal: I believe the coal from which the gas is made, that is, the cannel coal of the district, is equally accessible both to Liverpool and Manchester?—I believe it is.

9905. Have you any doubt that the Manchester people would use it?—I know they do use it; I know they do use it occasionally; perhaps not all the year round, because, at some particular times, they may be out of it.

9906. By the Committee.] At what time in the evening were those Manchester lamps out?—They were not lighted the whole of that evening, to the best of my recollection; I did not get in from making my experiments to my hotel till about eight o'clock; as soon as it was dark I looked out of the window and saw the street lamps were not lighted; I also looked out again late; it was eleven o'clock when I was going to my chamber; I went to the door, and still observed they were out, and I said to a cabman, who was bringing some persons to the hotel, "How is it the gas is out to-night?" he said, "They have got a holiday."

9907. Was that on your last visit to Manchester?—Yes.

9908. Was your hotel at one of the principal parts of the town?—It was the Queen's Hotel, in the principal street in Manchester.

9909. On that night, at eleven o'clock, there were no lamps?—No; and they were not lighted that night, as far as I could observe.

9910. Mr. Vaughan.] Was there a moon that night?—There was a full moon.

July 25th.

Mr. *Alfred King* recalled, and further examined.

10422. Mr. Sergeant Bellasis.] I understand you think your evidence yesterday implied that the capital of the Liverpool Gas Company yields a dividend of 10 per cent.?—Yes, I believe I have produced that impression, whereas the truth is, that £10 per share is not 10 per cent. upon the capital; a large portion of the capital has been, and all the future capital is to be, raised by sales by auction; the shares are sold by auction, in lots of one share each; all premiums arising from the sale of those shares are applied to the capital purposes of the company, but bear no dividend; the operation is this: if a person attends one of those sales and purchases a share for £150, or £50 premium, he never can receive more than £10 as his dividend upon that share, or something like 6 $\frac{2}{3}$ per cent.

10423. Your capital now, I believe, is raised by sales by auction?—Yes; there is another point upon which I wish to explain. I think the impression I produced upon the minds of the committee was, that that dividend of £9. 15s. was arbitrarily fixed in order to avoid attaining the maximum. That is not so; £9. 15s. is the sum arising from the whole divisible profits of the company; the company is bound to divide the whole of its profits.

10424. Mr. James.] I understand that the profits by the Gas Clauses Bill are limited, as by the Water Company's Bill, to £10 per £100 on the paid-up capital?—Yes.

10425. So that the dividend is 10 per cent. upon the paid-up capital; but a share of £100, by reason of receiving that dividend, or the probability of it, is worth in the market £150?—Yes, that is true, but it must be recollected that the party possessing that share might give £150 or even £200 for it.

10426. Upon the actual purchase it is not supposed that he receives 10 per cent., but having purchased a paid-up share of £100 he is entitled to receive 10 per cent.?—Yes; the public gains the advantage of this additional £100.

10427. By the Committee.] The happy holder of an original share paid only £100 for it, and receives £9. 15s.?—Yes, as respects the original shareholders.

10428. Mr. Sergeant Bellasis.] As respects the additional capital to a large amount, it is not the buying of a share paid up, but it is paying £170 for the privilege of getting £10 per cent.?—Not £10 per cent., but for the privilege of getting £10.

Miscellaneous News.

CITY OF LONDON COURT OF SEWERS.—July 15, 1851.

A Court of the Commissioners for the City was this day held in their chamber at the Guildhall. Mr. Deputy Peacock presided.

The minutes of the former court having been allowed as correctly entered, and the usual routine of business disposed of, Mr. Dakin, one of the members of the Court of Common Council, and the chairman of the Great Central Gas Consumers' Company, appeared at the bar for the purpose of laying before the commissioners a memorial from that company, which was as follows:—

"28, Coleman-street, July 15.

"Gentlemen,—We have the satisfaction to announce that the bill incorporating and enabling the Great Central Gas Consumers' Company to carry out the object of their formation has passed into a law, after three years of struggling against opposition and difficulties with which it was, perhaps, never before the lot of any company to contend.

"The act contains clauses for securing to the citizens in perpetuity all the advantages the company was established to confer, and the result of present experience warrants the belief that both the shareholders of the company and the gas consumers of the City will realize all the benefits which our most sanguine expectations ever promised.

"We have no hesitation in saying that to the corporation, for entertaining the petitions of the citizens, and to your commissioners, for complying with their solicitations by granting us permission to lay down our pipes, the gas consumers of the City and of the metropolis at large are indebted for the great reduction in the price of gas which has ensued from the successful establishment of this company, thus adding another to the many proofs which experience affords of the paramount value of municipal institutions in furthering the objects of local good government.

"In conformity with the principles promulgated in the official report of your court, which led to the formation of the Great Central Gas Consumers' Company, we have always left an open door for co-operation or amalgamation with the old City Gas Company, in the confident expectation that, through the instrumentality of one prompt public-spirited company, a better article could be supplied at a cheaper rate, and that the offices of the company could be administered, and with less public inconvenience, by means of one capital, one board of directors, and one staff of officers than if the supply had to be furnished by competing bodies.

"We have, however, always prescribed two fundamental conditions of any treaty for coalition or amalgamation. One was, that the act of amalgamation should give to the public the same securities as our bill had provided, limiting the amount of capital as well as the price and quality of the gas, and retaining for the consumers all the proposed safeguards as to the testing of gas, the inspection of meters, and the auditing of accounts, the same as are contained in the act. The other consideration was, that our treaty for an amalgamation should be public and transparent, and that no agreement between the two companies should be binding without the assent of the shareholders and gas consumers of the Great Central Gas Consumers' Company, as well as of the Commissioners of Sewers, whom we regard as the municipal guardians of the public interest.

"As the Court of Commissioners have been doubtless informed by the public press, an agreement for amalgamating the City Gas Company with this company upon the foregoing principles has been executed by the two companies, and awaits only the final consent of the commissioners to be carried into immediate execution. We have left with them this moment a copy of the deed and of our report to the shareholders of this company and the consumers of gas, which we have the satisfaction to state received the unanimous consent of both bodies.

"We feel great pleasure in announcing that, since the reduction in the price of gas, the number of consumers has greatly increased, and arrangements will be proposed, as soon as the amalgamation takes place, by which the advantages of gas will be further extended to classes of citizens which have been hitherto excluded from its use by its heavy cost. The cheapness of the article has likewise led to its employment for many purposes of manufacture, machinery, and domestic use to which it was not before

applied, the consequence of which has been that the aggregate consumption has been increased to an extent that will require an enlargement of the works of the two companies.

"In anticipation of this result, this company purchased at Bow-common land sufficient for the manufacture of the entire quantity the City may at any time require; and we indulge the expectation, as citizens, that the time will arrive when it will be consistent with the interest of the amalgamated company to remove the manufactory from its present confined situation in the very heart of the City to an open country, where, with the aid of Mr. Croll's improved process of manufacture, it may be carried on without occasioning the slightest injury or offence.

"Under the foregoing circumstances we have to request you will give your consent to the deed of amalgamation into which we have entered.

"I have the honour to be, gentlemen, your obedient servant,

"By order of the Board,

"THOMAS DAKIN, Chairman."

The memorial having been read,

The CHAIRMAN inquired of Mr. Dakin whether he wished to add anything thereto?

Mr. DAKIN replied, that he had but little to say, but this he might state, that the company with which he had the honour to be connected had fully carried out all the pledges by which they had bound themselves to the court and the public. (Hear.) All they now sought to obtain was that the original benefits contemplated by the promoters of the Great Central Gas Consumers' Company might be secured to the public under the deed of amalgamation.

Alderman SIDNEY was glad to see the result at which both companies had arrived as to the amalgation fixed upon; but still he was desirous of asking the chairman of the Great Central Gas Consumers' Company this question:—Had they made any provision in the deed for the removal of the gas works belonging to the City Gas Company from the heart of the City? Such a step certainly was most desirable.

Mr. BLAKE interposed. He thought the worthy alderman to be out of order.

The CHAIRMAN ruled that Alderman Sidney was in order, as he had merely asked a question in explanation.

Mr. DAKIN, in answer to Alderman Sidney's question, replied that no such clause was contained in the deed, and he (Mr. Dakin) wondered that the worthy alderman should have asked such a question. (Hear.) To call upon the company to do such a thing was more than could be expected; still he (Mr. Dakin) wished to state that it was the intention of the amalgamated company to remove the works from the City as soon as they possibly could. (Hear, hear.)

Mr. H. L. TAYLOR wished to ask the chairman of the Great Central Company (Mr. Dakin) whether there was any guarantee in the amalgamation deed which secured to the public a reduction in the price of gas below the existing rate of 4s. per 1000 cubic feet?

Mr. DAKIN replied, as we understood, that the price of gas per 1000 cubic feet would not be lower than 4s. unless the dividend rose higher than 10 per cent. When it did so the surplus was to be appropriated to a reduction in the price. There would be no reduction until 10 per cent. was realized.

Mr. BARBER remarked that he was glad to find, from the statement of the chairman of the Great Central Gas Consumers' Company, that there was no probability of the price of the commodity being increased by the amalgamation of the two companies. (Hear.)

Mr. Deputy HARRISON, in rising to move that the court do agree to the amalgamation as proposed in the statement laid before the commissioners by Mr. Dakin, said that it gave him unmixed pleasure to witness the unanimity which prevailed upon that occasion. He was delighted the more at this because he believed that the course proposed would not only prove beneficial to both companies but also to the public. (Hear, hear.) The advantages which had been realized were not to be estimated as a mere money reduction; there was something more. Gas, in consequence, was required in many ways; and even now it had been proved, although the long evenings had not set in, that the extensive works of both companies were scarcely equal to supply all the light and heat required by the public. (Hear, hear.) Without taking up another moment, he would move "That the court agree with the proposition." (Cheers.)

Mr. Deputy STEVENS seconded the motion.

Mr. H. L. TAYLOR said that he wished to make a few remarks upon the proposition then before the court. He thought the commissioners ought to hesitate before they agreed to a deed with the terms of which they were but partially acquainted. (Cries of "Oh.") He repeated they ought not to give their sanction to any deed unless they were fully acquainted with its provisions. He knew that in that court anything submitted in favour of the Great Central Gas Company was sure to be passed by a large majority, but he would put it to the sense of the court whether it was right for them to pass such an important document without due consideration. (Hear.) In order to test the opinion of the court he (Mr. Taylor) would give the court an opportunity of deciding the question by proposing an amendment, which was, "That the documents put in be referred to the general purposes committee for their consideration and report." (No, no.) He did not do this for the purpose of negativing the proposition altogether, but in order to give the commissioners an opportunity of being satisfied that the deed embraced all that was necessary, and that the amalgamated company would be compelled to do all they had pledged themselves to do. The chairman of the Great Central had told them that no reduction in the price of gas to the consumer was to take place until 10 per cent. was realized. Well, if this was so, let them ask themselves what they were going to do. Why, he had been informed, upon the best authority, that the amalgamated company never would pay 10 per cent. (Laughter.) What would be the result? Why, that the price to the consumer never would be reduced below 4s. per thousand. (Renewed laughter.) Was that what they wanted? (Ironical cheers.) But this was that which they would gain, notwithstanding all that that "free trader in gas," Mr. Deputy Harrison, had told them. (Laughter.) He (Mr. Taylor) was ready to pledge his word that if they adopted the proposed deed of amalgamation they never would obtain any further reduction in the price. (Hear.)

A COMMISSIONER suggested that the Chartered Company might furnish the gas still lower.

Mr. TAYLOR, in continuation, remarked that might be so, and he, for one, would, under the circumstances, rather burn the Chartered than the "Amalgamated" gas. (Laughter.) He regretted that the City Company had consented to such an amalgamation as that alluded to. He would say to both companies, "A plague on both your houses"—(renewed laughter)—and he would say further, that the reason he regretted the amalgamation was that, notwithstanding all the City Company had done, though they had given to the new company a weight of respectability it had not possessed before, they had still failed in giving to it that position which would command anything like a share of public confidence. Then as to the quality: were they not to have gas of the best quality, and was it not even now the fact that the Great Central gas was stuff of the most wretched quality? (No.) Why, the gas of the City and Chartered was equal in illuminating power to 13 candles per burner, while that of the Great Central was only equal to 9½ candles. Then they were to have public auditors and inspectors. Where were they, and how would they be guaranteed by the deed? Under all the circumstances, therefore, he considered that time was required for consideration, and he would consequently submit the amendment, "That the application be referred to the general purposes committee for examination and report."

Mr. Deputy KEBBEL seconded the amendment.

Alderman FINNIS justified the Great Central Company. The promoters, he was certain, had fully and honourably performed all their engagements; and, as an extensive gas consumer, he would say that the quality of the gas was far superior to that furnished by the old companies.

Mr. BLAKE said that it ought to be remembered that the deed had been submitted to the solicitor to the commission, and approved of by him. (Hear.)

Mr. Deputy HARRISON having briefly replied, the question to agree with the proposition was put and carried, Mr. Taylor and Deputy Kebbel being the only parties in favour of the amendment.

JULY 29.

A Court was held this day—Deputy Peacock in the chair. Several of the aldermen were present, and a considerable number of the commissioners belonging to the Court of Common Council.

THE GREAT CENTRAL GAS CONSUMERS' COMPANY.

A letter was read from the directors of the above-named company requesting the commissioners to grant to them liberty to lay down along Cheapside, the Poultry, Leadenhall-street, &c., a new main for the conveyance of gas from their works at Bow-common, the main to be twenty-four inches in diameter.

Mr. Tickner, the assistant clerk, having read the communication,

Mr. H. L. TAYLOR wished to ask the court whether in this year of 1851 they, as the commissioners of pavements, were likely to permit Cheapside, the Poultry, and the other leading thoroughfares to be ripped up as proposed? He certainly considered the proposal to be one of an inconsistent character. ("Hear," and "No.") He hoped really that the commissioners would not lend themselves to anything like such a monstrous application. (Oh.) He must say that he could scarcely restrain his indignation at the proposition.

Deputy HARRISON defended the application. It was necessary that the leave asked for should be given, as it was the fact that, so greatly had the demand for gas increased since the reduction of the charge, neither the Great Central nor the City Companies had the means with their existing mains of satisfying the requirements of the public. (Hear.)

It having been suggested by a commissioner that inquiry should be made of the company as to whether they would not put off the laying of the pipes until October or November next,

Mr. Croll, who was present, stated that to delay the work that time would be productive of evil consequences both to the company and the general public. (Hear.)

After an exceedingly long and angry discussion on both sides, the matter was set at rest by the chairman, on the suggestion of Mr. Taylor, who called the attention of the court to a clause in the Great Central Gas Consumers' Act, 14 and 15 Victoria, c. 69,* which provides that three months' notice of the laying or relaying of any pipe must be given to the court. This objection was held to be fatal, and the conversation dropped, Deputy Harrison and some other commissioners protesting against the construction of the clause cited.

Shortly afterwards the commissioners adjourned.

RAW MATERIALS AT THE GREAT EXHIBITION.†

(Continued from our last.)

These facts serve in some measure to explain, though we cannot allow that they in any way justify, the present condition of the zaffre market; since these very difficulties are daily overcome in one of the largest metallurgical operations carried on amongst us. Many of the ores of copper, when first received by the manufacturer, are in a state quite parallel to that of the Cornish ores of cobalt, even in regard to poverty of metal. There is the same excess of granitic matrix, the same necessity for avoiding the use of any agent capable of attacking sulphuret of copper, a substance possessing very similar

* The 30th clause of this Act is to the following effect:—"That, if the company shall be desirous of laying down in any street within the city of London, or the liberties thereof, any new line of main pipes for gas, or of altering the pipes, or the line of any existing main, in any street within the said city or liberties, they shall give at least three months' notice, in writing, to the commissioners of sewers of the city of London of such desire, and shall state in such notice the name of the street, and the particular part thereof, in which such line of main pipes is intended to be laid down, and the material and diameter of such pipes, and the day on which the work is proposed to be commenced, and the time within which it will be completed."

† From "Newton's London Journal and Repertory of Arts, Sciences, and Manufactures."

chemical affinities to those of the arseniurets of nickel and cobalt. What, then, is the flux employed by the copper-manufacturer in such cases? We reply at once, it is the protoxide of iron, which is formed from these poor copper ores by the action of heat, and combines with the silica of the matrix so as to produce an extremely fusible silicate of iron, which permits the sulphuret of copper to fall down to the lower part of the reverberatory furnace, whilst the vitrified impurities of the ore are raked from its surface. Oxide of iron would most probably, therefore, enable a manufacturer accustomed to furnace operations to send into the market an arsenical compound of cobalt containing more than 50 per cent. of this metal, even if his interest failed to convince him of the great advantage resulting from its subsequent conversion into zaffre. Thus, then, the conditions of this seemingly difficult problem are answered, in a commercial sense; for oxide of iron is plentiful and cheap, its combination with silica is sufficiently fusible, and it has no action whatever upon metallic arseniurets. No doubt many other substances might be found equally applicable with the one we have mentioned; and, indeed, our object in thus dilating upon this and analogous topics is rather to stimulate inquiry than lay down specific rules for practical guidance; consequently our remarks must be regarded at best as but a shadowy outline, the manufacturing details of which require careful filling in, to render the whole intelligible and useful.

Before quitting the subject of cobalt, it may be as well to advert to a peculiar ore of that metal found near Keswick, in Cumberland. This ore contains from two to three per cent. of cobalt, but is quite free from nickel, a very unusual circumstance; as even in meteoric stones cobalt is constantly accompanied by nickel, though this last metal not unfrequently exists without cobalt. As a colouring material oxide of cobalt is seriously damaged by the presence of oxide of nickel, for these oxides produce colours almost complementary to each other; and therefore tending, by their admixture, to yield a neutral tint, as is observable when their saline solutions are united. The great advantage of working an ore of cobalt free from nickel must, consequently, be obvious to all. The Keswick mine is, nevertheless, almost abandoned at the present moment, through sheer inability to find a market for its produce; though for the finer kinds of porcelain, and for enamel painting, the oxide of cobalt, procured from it, is worth fully a guinea per lb.

In the hope of drawing attention to a raw material at once so unique and valuable, we give the following original process for extracting pure oxide of cobalt from the Keswick cobalt ore:—Having carefully roasted a quantity of this ore, at a full red heat, in a muffle furnace, for two or three hours, it is next to be reduced to a fine powder, and then digested in muriatic acid of the specific gravity 1·10, or thereabout. And for this use the waste acid of the soda-maker is well adapted, even though it may happen to contain arsenic and iron. After a few hours' digestion the acidulous solution may be poured off and fresh acid added, so as completely to exhaust the roasted ore, and dissolve all the metallic matter in it. Then mix the solutions thus procured; and, having thrown in a portion of powdered hœmatite or other form of peroxide of iron, evaporate the whole to dryness. Next pour boiling water on the dried mass, and stir in an excess of chalk, whiting, or finely-powdered marble, and preserve the whole at a temperature of about 180 deg. Fahr., until all evolution of carbonic acid ceases; then add a quantity of sulphate of soda and throw the mixture on a filter, when a solution of chloride of cobalt will pass through, containing a small quantity of the sulphates of lime and soda, but altogether free from metallic contamination. This solution must now be supersaturated with a caustic lye of soda, and the mixture boiled for a few minutes, in order to ensure the rapid precipitation of the oxide of cobalt; which, after careful washing with hot water, is to be dryed and heated red hot, in a crucible, to give it the character suitable for the English market. One pound of Keswick ore will require about eight ounces of muriatic acid, of the kind alluded to, with two ounces of hœmatite, three ounce of chalk, and the same quantity of salt cake or dry sulphate of soda. The explanation of this process is very simple: in the first instance the metallic matters of the ore, consisting of iron, cobalt, arsenic, copper, and perhaps also lead, are dissolved by the muriatic acid; and, as all of these are precipitated by carbonate of lime, except cobalt, the chalk might now be added at once, but for the fact that the Keswick ore contains an excess of arsenic, which carries down a portion of cobalt in the state of arsenite of cobalt. To remedy this evil peroxide of iron or hœmatite must be added, so as to ensure the existence of an excess of peroxide of iron in the solution; as this, on the introduction of the chalk, will unite to the arsenic, and thus prevent the precipitation of any cobalt at this stage of the operation. The cessation of all effervescence indicates that the chalk has ceased to act, and that the iron, arsenic, copper, and lead are no longer in solution, but have been displaced by the lime of the chalk. To remove this lime, sulphate of soda is employed, since this throws down nearly the whole of the lime in the state of sulphate; after which caustic soda or potash will precipitate nothing from the filtered solution but pure oxide of cobalt. Although apparently somewhat complex in detail, this process is extremely simple and efficient in practice; and possesses, moreover, the advantage of being equally applicable to the treatment of speiss or arseniuret of nickel, from which pure oxide of nickel may easily be procured, using, however, much more hœmatite than the quantity indicated above, in consequence of the absence of iron in speiss. From this latter circumstance it must be obvious that cobalt and nickel cannot be separated in the way just described; for, as has been stated, they both remain in solution after the employment of the chalk; and, indeed, no process has yet been published by which a perfect separation of these two metals can be effected. Ordinary Swedish zaffre contains, on an average, fifteen per cent. of oxide of cobalt, mixed with about three per cent. of oxide of nickel; which latter seriously impairs the colouring power of the zaffre. Hence it is that we have entered thus fully into this question; for, as it is almost impossible to purify cobalt when contaminated with nickel, it is a kind of national disgrace to Great Britain that, having a pure ore of cobalt in the very centre of the island, our manufacturers are unable either to compete with, or so much as contest for the palm of superiority in, the formation of zaffre.

The only other metallic minerals of any consequence remaining to be noticed in Class I. of the Great Exhibition are those of tin; and these well illustrate the great difficulty of improving, or even suggesting an improvement, in an old-established manufacture. Substituting charcoal for the common coal, now used, it is every way probable that the mode of reducing tin ore, practised by the Phœnicians more than 2000 years ago, was almost identical with that pursued at present in Cornwall. Of course improvements have taken place in the apparatus for washing and grinding the ore, and in the form and construction of the furnaces. But these, after all, are mere corollaries upon other manufactures, and present no such marked change as may be seen in many other things; for example, in the puddling of iron, or the formation of glass. The extraction of tin from its ores is too simple an operation to admit of any very decided alteration for the better; and the only modern invention worthy of that name is the fabrication of the alkaline salts of tin from the ore direct, instead of, as heretofore, from the metal itself. Thus the stannate of soda, a substance pretty freely used in dyeing and calico printing, is now made by merely boiling the native oxide of tin, or tin-stone, as it is called, in a caustic solution of soda; by which the oxide is dissolved, and unites with the alkali, to form stannate of soda. An example of this new development of industry is exhibited in Class II. of the Crystal Palace, where Mr. Young, of Manchester, displays both a model of the apparatus he employs, and samples of stannate of soda thus produced. It might be conjectured that, in an art so delicate as dyeing, some danger was to be apprehended, lest any silicic, tungstic, titanic, or arsenious acid might be occasionally taken up from the ore; but experience seems to prove either that this is not the case, or that these substances do not impair or alter the proper action of the stannate of soda.

Immediately abutting, as it were, on the confines of raw material, the manufacture of coal-gas claims attention, from its amphibious position and multifarious uses. As bituminous coal, when subjected to the action of a red heat, invariably gives off gaseous matter wherever placed, it becomes necessary to distinguish between the production of coal-gas and its manufacture. Our ancestors were producers of coal-gas; but the manufacture of this important agent belongs to the present century; and therefore we are able, without any difficulty, to speak of the production and manufacture separately. The production of gas from coal depends altogether upon the application of a high temperature; for, at a heat verging on 400 deg. Fahr., the volatile constituents of coal pass off in the shape of fluid hydrocarbons, or naphtha, with little or no admixture of any permanent gas. If, however, the temperature employed be that known as a full cherry-red heat, or something higher, then the volatile constituents are, for the most part, resolved into permanently elastic fluids or gases, with a trifling production of tar and naphtha. Too high a heat is, however, apt to induce some grave inconveniences, as will appear farther on; and hence the gasmaker, in its first process, sails between a kind of Scylla and Charybdis, having to dread an excessive production of tar on the one hand, and the evils just alluded to on the other. Presuming, however, that the proper temperature has been secured, the successful production of good coal-gas is not yet ensured, unless the coals, before their introduction into the retort, are free, or nearly so, from water. Coal is a bad conductor of heat; and therefore, when a quantity of this substance, in a wet condition, is thrown into a red-hot retort, as practised by gas-manufacturers, the outer portion of this mass becomes carbonized and converted into red-hot coke long before the water in the centre of the coal has been expelled; consequently, as the heat penetrates through the coal, this water is vaporized and driven in the form of steam over the red-hot coke on the surface, with the production of three gases, viz., hydrogen, carbonic oxide, and carbonic acid,—all of which are injurious to the gasmaker; the two first, by diluting his gas and lowering its illuminating power; the last, by neutralizing the lime contained in the purifier; and thus needlessly causing an increased consumption of that article. But the presence of water in coal is also detrimental in another way; for its conversion into steam implies the absorption of an immense amount of heat, since the latent heat of steam is upwards of 960; consequently, as this absorption takes place immediately previous to the decomposition of the bituminous constituents of the coal, a disposition results to generate at that time a temperature capable only of producing tar or naphtha, but scarcely equal to the formation of coal-gas; and thus water not only tends to reduce the quality but also to lessen the quantity of gas procurable from any given coal; therefore its absence in coals intended for gas purposes should always be ascertained prior to their employment.

We have previously remarked that too high a temperature ought to be avoided in the production of coal-gas, and this for two very important reasons. In the first place, heavy carburetted hydrogen, or olefiant gas, is decomposed at a white heat, or, even under this, with the formation of light carburetted hydrogen, and the production of charcoal or carbon; thus greatly diminishing the value of the gas as an illuminating agent. The second reason is still more conclusive:—All coals contain iron pyrites, which, at a low red heat, is decomposed into protosulphuret of iron and free sulphur; the latter, uniting to a portion of the hydrogen of the coal, passes off, and is found in the gas in the shape of sulphuretted hydrogen, leaving the protosulphuret of iron in the retort. But it will be remembered that, in speaking of coke, we mentioned that this protosulphuret of iron was resolved, by a high and long-sustained heat, into metallic iron, which remained in the coke, and into bisulphuret of carbon, which escaped. Now, the application of a high heat in gas-making has exactly the same effect as in coke-making, and produces, in both cases, bisulphuret of carbon, which, mixing with the coal-gas, can

never afterwards be removed. It consequently remains in the gas; and, when this is burnt in the ordinary way, gives rise to the production of sulphuric acid, or oil of vitriol; and this, although generated by most of the common gas of our streets in an infinitesimal quantity, is nevertheless found sufficient, in a few years, to attack and destroy the binding and paper of the books in our public libraries, and corrode articles of iron, steel, brass, or copper. This important fact has not received a proper share of consideration from our best gas engineers until within the last few months; and hence many of the old libraries of London can now furnish books completely discoloured and rotted through a great portion of each page, though in a few years all further traces of this mischievous effect of gas will have vanished.

Having thus far commented on the production of coal-gas, we next pass to the examination of the processes employed in rendering it pure and fit for the uses to which it is applied in common life. The first process is that of condensation, by which nearly the whole of the vapours, properly so termed, are condensed and separated from the permanently elastic gases. By this means, tar, water, naphtha, carbonate, muriate, and hydrosulphate of ammonia, are removed from the gas,—the only impurities of which now are, carbonate of ammonia, carbonic acid, and sulphuretted hydrogen. Water alone will remove all three of these impurities; but its action is weak, and chiefly exercised upon the first. Hence, although usefully employed for attracting carbonate of ammonia (as exemplified in Lowe's scrubber), it is not used by gas engineers of the present day with a view to total purification,—this being sought for in the superior affinity of lime, after the ammonia has been arrested by other means. Coal-gas, after condensation, usually contains about two per cent. of carbonic acid, and one per cent. of sulphuretted hydrogen; but these vary, of course, with the nature of the coal; and also, as we have stated above, with the dryness of the coal, which has much to do with the production of carbonic acid. These proportions may, however, be regarded as a fair average of Newcastle coal-gas, and would justify the consumption of about 40 lbs. of lime for every 10,000 cubic feet of gas,—a quantity which, although far below the proportion expended in common practice, is really very near the consumption of lime actually carried out at the Westminster station of the Chartered Gas Company, by Mr. F. J. Evans, during a long course of carefully-conducted experiments; and ought, therefore, to be kept in view as an ultimatum by gas engineers. Where much more lime than this is found indispensable to good purification, there is reason to suspect either that the coal is damp, or that it contains more than an average quantity of sulphur. The amount of sulphur in good Newcastle coal is as nearly as possible one per cent. by weight, and in some of the cannel coals it is even less; thus, Boghead cannel, for example, has barely one-half a per cent., or ·54, of sulphur, on an average. How necessary then is it that every gas engineer should be able to determine the quantity of sulphur existing in coal! but even this, without other knowledge, is worthless and deceptive. Sulphur seems to be present in coal in two states: the one and most frequent is that in which it is united to iron, as bisulphuret of iron or pyrites; the other is in a doubtful state of combination, but probably it exists conjoined to the bituminous elements of the coal in the state of sulphur. To the gasmaker this difference is very important, as in the former case one-half only of the total sulphur would pass away with the gas and contaminate it, whereas in the second the whole would be carried to the purifying vessels; consequently, in determining the amount of sulphur in coal, a gas engineer must ascertain first how much sulphur the pure coal contains, and next how much sulphur remains in an equivalent of the coke of such coal; after which the latter must be deducted from the former to get at the sulphur contamination of the coal when its value for gas purposes is sought to be determined.

The following detailed explanation will furnish the gas engineer with a means by which coal may be analyzed, with a view to the object in question:—Having carefully reduced a fair sample of the coal to a very fine powder, mix 100 grains of this powder with 50 grains of pure and dry carbonate of soda; after which place the mixture in a clean iron ladle, and roast the whole over a brisk fire, at a good red heat, for several minutes, so as to burn off the whole of the coal, or nearly so; then remove the ladle from the fire, and when it is cold add 50 grains of pure and powdered nitre, mixing this well with the residue of the coal and carbonate of soda; after which place the ladle again on the fire and keep it red hot for a few minutes, when it must be again removed, suffered to cool, and its soluble contents washed out with water and thrown on a filter. To the filtered liquor an excess of pure nitric acid must be added, and then a solution of nitrate of baryta dropped in until all precipitation ceases; when the sulphate of baryta, thus formed, may be allowed to settle, or be thrown on a counterpoised filter, washed, dried, and weighed. Its equivalent, or 117 grains, indicates 16 grains of sulphur.

Having thus determined the quantity of sulphur in the coal, 100 grains more of the powdered coal are to be taken and placed in an earthen crucible, provided with a closely-fitting cover; when the cover is put on, the crucible is subjected to a red heat until inflammable gas is no longer evolved; the crucible must then be removed from the fire and covered up in dry sand to cool. As soon as the crucible is cold, remove the coke it contains; and, after reducing it to a fine powder, mix with it 50 grains of pure and dry carbonate of soda; place the whole in an iron ladle, and proceed exactly as indicated above with respect to coal. The amount of sulphur found in the coke must then be deducted from that previously ascertained to exist in the coal,—the difference being the true sulphur contamination of the coal under examination.

In our next we shall continue the subject of coal-gas purification, with remarks upon the different methods of burning gas, and the results thence ensuing.

From what was previously stated concerning the impurities which exist in crude coal gas, it must be evident to those conversant with the principles of chemistry that these impurities can never be thoroughly removed by any single agent, for some of them possess affinities diametrically opposite to the others. Thus, any means employed to absorb carbonic acid and sulphuretted hydrogen gases would leave the ammonia free; whilst an agent capable of combining with the latter would not at all affect the former impurities. Hence, the process of coal-gas purification, as now carried on at the best gas works, is divided into two distinct parts. By one of these the whole of the ammonia and a portion of the carbonic acid and sulphuretted hydrogen are taken away,—by the other the remainder of the carbonic acid and sulphuretted hydrogen are totally removed; so that the gas ultimately passes forth to the consumer free from all contamination, either by ammonia, carbonic acid, or sulphuretted hydrogen gas. And the absence of these impurities may at any time be demonstrated by applying the following simple tests:—Litmus paper, slightly reddened by an acid, will undergo no change when held for a few minutes in a current of the gas; this proves the absence of ammonia, for otherwise the paper would become blue. Paper dipped into a solution of the acetate of lead, and held in a current of the gas, will remain white; which shows that the gas is destitute of sulphuretted hydrogen, as, under ordinary circumstances, it would assume a deep brown or black hue. Lastly, if the gas be allowed to blow for a few minutes through a clear solution of lime in water, the solution will not become milky and turbid, as it would do if carbonic acid were present in the gas. No coal gas which does not vindicate its purity by resisting the analytical power of the above tests can be regarded as sufficiently good for the purposes of illumination and heating.

To separate the ammonia from coal gas a variety of modes are at present in use; thus, Mr. Lowe employs cold water, minutely divided in an apparatus which he terms "a scrubber," and which is perfectly analogous to the cascade chemique of Clement Desormes. With a similar view Mr. Palmer mixes the gas with steam, and then subjects the mixture to a condensing temperature, so as to obtain water, minutely divided in drops, like rain or dew, and therefore presenting a considerable surface for chemical action. Mr. Johnson prepares a compound consisting of sulphate and biphosphate of lime, by acting on burnt bones with sulphuric acid; and this he disposes in trays, so as to absorb the ammonia and produce a mixture of sulphate of ammonia and phosphate of lime, which, as might be expected, he finds an extremely efficient fertilizing agent. Mr. Laming employs a solution of chloride of calcium or muriate of lime, absorbed into sawdust, which he disposes in the same manner as that followed by Mr. Johnson, and by which the muriate of lime is gradually decomposed, with the formation of carbonate of lime and muriate of ammonia,—the resulting compound being either valuable as a manure, or as a source for the manufacture of sal-ammoniac. Sulphate of lime, and various other earthy and metallic salts, have also been proposed and employed, such as the sulphates of magnesia, alumina, zinc, iron, and manganese, and the chlorides of the same metals. With the exception of the sulphate of lime, they do not, however, seem to possess any advantage over the modes we have mentioned as now in use for the absorption of ammonia; and hence it may be as well to examine more minutely the action of those methods, and their effect upon the gas undergoing purification. The process of Lowe is extremely simple in theory, and, where the economy of the ammonia is not an object of importance, has much to recommend it. Here the ammonia is, so to say, washed out by means of water; and the application of the scrubber may either be made before or after the other impurities are taken away, with, however, this difference in the result. If the gas, after quitting the condenser, is passed at once into the lime purifier, and the scrubber applied afterwards, nothing but ammonia will be removed by the water; but if the scrubber be employed in the first instance, then, with every atom of ammonia taken away, one of carbonic acid or sulphuretted hydrogen will follow, and hence a great economy of lime in this way arises; for the ammonia, though itself an impurity, thus becomes a purifying agent, and the liquid from the scrubber consists, not of aqueous ammonia merely, but of a solution of carbonate and hydrosulphate of ammonia. It is, however, very difficult to separate the whole of the ammonia, either free or combined with carbonic acid, by Lowe's scrubber, without the application of a very large body of water; and it has been suggested that excessive ablution diminishes considerably the illuminating power of coal gas. This circumstance, if true—and it is far from improbable—demonstrates the necessity of limiting the action of water upon gas, and must, in some degree, interfere with the employment of an otherwise invaluable instrument of purification. The plan of Palmer is precisely similar in its effect to the scrubber of Lowe, but more costly, and, except when conducted with great care, less efficacious, as the entire success depends upon the perfection of the condensation; for, unless the condensed water be cooled down to the mean temperature of the atmosphere, little or no ammonia will combine with it; and there is, moreover, a still greater danger of injuring the light-giving power of the gas by condensed steam than by an equal weight of cold water. This method cannot, therefore, be considered as equal to the former, more especially when coal gas of low specific gravity is to be purified. The mere recital of Johnson's process almost details its mode of action; and it would scarcely be necessary to say more concerning it but for the contrast it presents to that of Laming, and the substances before alluded to. If the phosphate of lime, or bone-earth, mentioned as part of Johnson's mixture, be regarded as a sponge for holding the sulphuric acid which he employs, then the ammonia is taken up from the gas by simple elective affinity with the production of sulphate of ammonia; and this is, beyond doubt, a true explanation of the modus operandi in Johnson's case. Here, however, it will be noticed that nothing but ammonia is removed, for the carbonic acid and sulphuretted hydrogen remain unaffected; consequently this system might be employed either before or after lime purification. Now, Laming's plan differs altogether from this; and, as will readily be seen, admits of application only before lime purification. The foul coal gas from the condenser contains (as we pointed out in

our last number) carbonate of ammonia in a gaseous condition; and it has just been shown that the process of Laming depends upon the use of muriate of lime. But, at the ordinary temperature of this country, these two substances are incompatible with each other; and, consequently, as fast as the carbonate of ammonia is brought by the current of gas into contact with the muriate of lime, mutual decomposition ensues, and both the ammonia and carbonic acid are solidified, the former becoming converted into muriate of ammonia, and the latter into carbonate of lime, by an interchange of elements with the muriate of lime used in the process; therefore the result differs thus far from that of Johnson,—that carbonic acid, as well as ammonia, is taken from the gas, and a consequent saving of lime, or other purifying material, effected; of course sulphate of lime would act in the same way, though less powerfully; whereas metallic salts, in general, having more affinity, after decomposition, for sulphuretted hydrogen than for carbonic acid, will produce an economy of lime by removing the former and not the latter impurity. Such, then, is a descriptive outline of the methods actually followed at the present day for the purification of coal gas from the ammonia it contains; and, although seemingly abundant enough to have exhausted the subject, yet there is still an extensive field open to improvement even here.

Amongst the large class of ammoniacal compounds known to chemists, it seems strange that no one has yet taken advantage of that interesting series which suffers decomposition by the mere application of a moderate temperature, evolving at the same time pure ammoniacal gas, and yielding, as a residue, the substance originally employed for purification. We shall enumerate but one or two substances of this kind for the purpose of illustrating our argument,—leaving the whole question as open as ever to practical investigation. When phosphate of magnesia is exposed to the action of ammoniacal gas, its acid becomes divided in such a way as to produce the triple salt called ammoniaco-phosphate of magnesia; and, as this is a much more insoluble substance than the simple phosphate, we have only to pass impure coal gas through a solution or aqueous mixture of the latter, to ensure the precipitation of all the ammonia contained in the gas; whilst, at the same time, the compound which it has formed with the phosphate of magnesia is very easily decomposed, so as to admit of a continuous usage of the same material; for, at a temperature considerably below a red heat, the triple phosphate of magnesia parts with all its ammonia, and becomes simple phosphate again, with the renewal of its primitive power as an absorber of ammoniacal vapours; but the ammonia which is expelled by heat might very easily be condensed in water, and thus originate a valuable commodity for the market. By this means there can be no doubt phosphate of magnesia might be employed over and over again in the purification of coal gas, whilst the ammonia procured from it would contain neither sulphur nor any other impurity. An iron vessel might be used for the distillation, and, if too high a heat was not given to the phosphate of magnesia, its purifying action would remain unaltered, thus presenting altogether a fair opening for the investment of talent and industry. Similarly, boracic acid deserves attention from the facility with which, even at the temperature of boiling water, it parts with the greater portion of any ammonia previously united to it, at the ordinary heat of the climate in this country. It offers, consequently, a commodious vehicle for collecting and conveying the ammonia of gas works into public use without the risk of nuisance or loss. Many other substances possessing this double property of absorbing and giving off ammonia, by a trifling change of temperature, might be pointed out, but this lies beyond our province; it is the principle only which we attempt to elucidate, with a view to its practical application in some specific instance.

Presuming that the impure gas has had all its ammonia separated by proper treatment, we have now to consider in what way the carbonic acid and sulphuretted hydrogen may be most easily got rid of. Lime is the agent commonly selected, and, all things duly admitted, there is a great mass of evidence in its favour—so much so, indeed, that, until lately, it has had no competitor. At present, however, the oxide of iron is becoming a formidable rival, and, therefore, we propose to examine into their respective merits, which, after all, are less alike than might be supposed in two substances selected to perform one and the same operation. When properly prepared and moistened, lime removes from impure coal gas both carbonic acid and sulphuretted hydrogen with extreme energy, and, consequently, effects thorough purification after the ammonia has been got rid of. Oxide of iron combines only with the sulphuretted hydrogen contained in the gas, and not with the carbonic acid; so that coal gas purified in this way requires the subsequent application of lime, or some other material capable of combining with carbonic acid. Thus far, therefore, the advantage is much in favour of lime; but, when lime has absorbed all the impurity it can attract from coal gas, or, in technical phrase, becomes "foul," it is not only altogether useless, but, much worse than this, it is a serious nuisance, in consequence of the evolution of sulphuretted hydrogen the moment it comes in contact with atmospheric air, which arises from the action of the atmospheric carbonic acid upon the hydrosulphate of lime contained in the foul mass. Gas-lime refuse is, therefore, a grave inconvenience to many gas companies. Now, with oxide of iron no such inconvenience is felt; for this substance, in uniting with sulphuretted hydrogen, produces a compound which yields no noxious or unhealthy emanations by contact of air, but is, under such influence, simply oxidized, and in a great measure restored to its primitive power; so that it may be used over and over again ten, twenty, or even thirty times in succession. These peculiarities give the oxide of iron a decided superiority in many situations, though up to the present moment its practical application has been extremely limited. When lime contained in a purifier has ceased to purify gas, the general impression is that it has been wholly resolved into carbonate and hydrosulphate of lime; but this is very far indeed from being the case, for even the foulest lime seldom contains less than one-fifth of all its lime, free or uncombined; and gas-lime refuse is occasionally to be had so imperfectly saturated that fully one-half of the lime paid for by the gas company may be said to be thrown away. In the first place, it is not customary to examine the lime itself, so as to determine its chemical value or combining proportion; and, still worse, it is not usual, secondarily, to analyze the lime refuse with a view to ascertain how much lime is passing away unacted on. As both of these desiderata may be secured without the application of any great chemical skill, we shall proceed to give a brief description of the means needed to solve these trifling problems, beginning with the lime itself. Having selected from the bulk a fair sample of lime, let this be ground to a fine powder in a clean and dry mortar; then weigh out 100 grs. of the powder, and place it in a tumbler or other suitable vessel, where it is to be repeatedly washed with a warm but not hot solution of sal-ammoniac in water, the temperature being about 80 or 90 deg. Fahr. Great care must be taken that, in washing the lime, no solid particles are allowed to escape with the ammoniacal solution, and, as soon as it is observed that the fluid containing the sal-ammoniac ceases to restore the colour of reddened litmus paper after it has been poured upon the lime, then common water may be used to wash the remaining lime, after which it must be dried at a red heat and then weighed; the loss will indicate the amount of pure lime present in the 100 grs. taken. This mode of analysis depends upon the fact that lime, at the temperature indicated, decomposes muriate of ammonia and becomes soluble; but any carbonate of lime, silicate of lime, alumina, or other inactive impurity remains behind undissolved, and may, therefore, have its quantity determined by the balance.

Foul gas-lime or refuse is somewhat more complex, but, nevertheless, far from difficult in its analysis. Having, as before, selected a fair sample, let 200 grs. be weighed out and placed in a stoppered bottle, with an equal weight of sal-ammoniac, and four ounces of water heated, as before, to about 80 or 90 deg.; shake the whole well together, and keep the mixture warm for twenty minutes; then filter rapidly into a stoppered retort, and wash the filter with two ounces of hot water, which are to be added to the filtered solution. Next distil over one-half of the fluid into a receiver containing 100 grs. of sulphate of copper dissolved in water, and set the fluid remaining in the retort aside to cool. Collect the black precipitate now contained in the receiver upon a filter, and wash it well with hot water, then dry and weigh it. It is the sulphuret of copper, and contains one-third of its weight of pure sulphur. The fluid in the retort must now be mixed with an excess of carbonate of soda, and the white precipitate which ensues well washed, dried, and then weighed. One hundred grains of this precipitate, which is carbonate of lime, indicate 56 grs. of pure lime; and, if from this we deduct the quantity combined with sulphuretted hydrogen, as given by the sulphuret of copper, the remainder will be the total quantity of pure lime in the 200 grs. of gas-lime refuse which had not been utilized in the purifier. Thus, suppose that 200 grs. of any sample in question have given 24 grs. of sulphuret of copper and 80 of carbonate of lime, then the total amount of lime will be 44·8 grs., from which 14 grs. must be deducted for that united to sulphuretted hydrogen, since the atom of sulphur is to that of lime as 16 to 28, and 24 grs. of sulphuret of copper contain 8 grs., or one-third of its weight, of copper, which is, consequently, equal to 14 grs. of pure lime. This supposed sample has, therefore, given 30·8 grs., or 15·4 per cent., of free lime. Thus, in place of the mere rule-of-thumb system too commonly pursued in gas works, a good gas engineer will control the entire produce of his manufactory by determining first the total amount of sulphur given off in a gaseous form by the coal he uses; next, the chemical power of his lime; and, lastly, whether or not the action and arrangement of the purifying apparatus is such as to ensure the proper saturation of the lime with the impure constituents of the coal gas. Without the occasional employment of analytical processes similar to those previously given, it is altogether impossible to conduct a gas works with that certainty and confidence essential to perfect economy.

It might be supposed that with the purification of coal gas the chief difficulties of a gas engineer ended; but this is very wide of the truth, for upon no point is there greater diversity of opinion and more discrepancy in result than exist regarding the proper mode of burning gas for the purposes of illumination and heating. As regards the former question, it seems hitherto to have been impossible of solution from the fact that quantity and intensity of light have been confounded together; and persons have been surprised to find that a bright white light, of great intensity to the eye, has, nevertheless, illuminated a given space worse than a large quantity of a dull yellow smoky-looking light. Thus, if, when an argand oil lamp is burning with great brilliancy, the central aperture for the admission of air be closed, the flame will immediately become yellow and smoky, yet, on examining the walls of the apartment, it will be found that they are better illuminated than with the more brilliant light. In the former case many of the particles of carbon are consumed before they take on the solid condition; whereas in the latter they are all separated from the hydrogen of the oil, and become red-hot solid bodies ere they enter into combustion. But, as the quantity of light is proportioned to the number of solid particles heated, and its intensity to the highness of the temperature to which they are heated, it follows that part of the carbon is employed in producing heat to give intensity of light to the remainder in the one case, whilst in the other the whole of the carbon, becoming solid, reflects a great quantity of light of less intensity. For the ordinary wants of society the latter is the best light. A knowledge of these matters enables us easily enough to explain the vast difference in illuminating power which one and the same gas displays when consumed in different burners. Thus, a thin gas, of low specific gravity, which affords an excellent light in an argand burner, will scarcely yield any light at all with a fishtail or bat's-wing; and a rich cannel coal gas, well adapted to either of the latter burners, requires infinite care to prevent it smoking in an argand. In determining the relative illuminating powers of different gases, it is, therefore, necessary to select for each gas that form

of burner best suited to display its light-giving properties, and not continue the present Procrustean system of cutting down the power of the gas to an arbitrary standard of burner,—the only result of which has been a series of assertions and contradictions too disgraceful for further notice.

In photometrical experiments a spermaceti candle, of a determined size, is commonly employed, and, in a rough way, answers remarkably well. But sperm, like wax and tallow, gives quantity of light, but not of an intensity equal to gas, as may be seen in a moment by contrasting the comparatively yellow flame of the one with the brilliant white light of the other. They are, therefore, like musical instruments tuned to a different pitch, and can never harmonize with each other. The better plan would be to select olefiant gas as a photometrical standard, since this compound is uniform in composition, and can be easily prepared at a few minutes' notice. It possesses, moreover, the advantage of being consumed in similar burners to that employed for the gas to be tested, and is under the influence of the same barometric and thermometric variations. The Bunsen photometer, as modified by Mr. A. King, of Liverpool, is, perhaps, the best instrument to employ in experiments on comparative illumination. Regarding the ultimate analysis of coal gas little need be said, as the results have no specific value or meaning. The only correct mode of analysis is by passing a known volume of the gas over oxide of copper in a tube, heated red hot, and collecting first the moisture by chloride of calcium; secondly, the carbonic acid by hydrate of lime or solution of potash, as followed in ordinary organic analyses; and, lastly, receiving the incombustible residue over water in the pneumatic receiver: from which three products the quantity of hydrogen, carbon, and nitrogen, may be deduced. The ultimate analysis of coal gas, as also the estimation of its value from the condensation of what is termed its olefiant gas, whether by chlorine, sulphuric or nitric acid, are processes of no practical value to the public, and serve only to mislead the ignorant.

From the vast reduction which is now taking place in the price of coal gas, its calorific power has become one of the most interesting questions of the day; and, when the waste of fuel consequent upon lighting a common fire with coal, and the loss arising out of the necessity for maintaining it, even though not wanted, are carefully inquired into, it seems very clear that, for at least four or five months of the year, it is cheaper to cook by gas in London than by coal, at the existing price of these articles. An apposite illustration of the correctness of this assertion is afforded by the warm bath of Mr. Defries, in which 45 gallons of water are heated from the temperature of 50 deg. to 100 deg. Fahr., by 30 cubic feet of gas, and at a cost of only three-halfpence. Now, to effect this at all by coal would entail an expense of at least fourpence; but to do so in the same period of time (five minutes) would certainly produce an outlay of not less than a shilling. Of course, where the operation is to be repeated, or go on continuously, a different result would ensue; but, for extemporaneous use, coal gas will always be cheaper than coal. But even this surprising economy has been exceeded by a very elegant arrangement, invented by Mr. F. J. Evans, of Westminster, in which a coil of iron tubing is so disposed as to present an immense surface to the heating influence of the burnt gas, and thus absorb the whole of the heat. In this way a current of cold water entering at one end of the tube flows out of the other continuously and at any required temperature, according to the velocity of the current and the quantity of gas consumed in a given time. For the requirements of the Humane Society, for public hospitals and charities, a simple apparatus of this kind must find a ready application, and deserves to be better known. According to direct experiments, made with great care, Mr. Evans has found that common Newcastle coal gas of specific gravity ·416 has an evaporative value equal to about 22 times its weight; or, in other words, that 1 lb. of such gas will convert, theoretically, 22 lbs. of water into steam; and this accords very well with the results given by Defries with his bath, in which 30 cubic feet of gas are stated to heat 45 gallons or 450 lbs. of water 50 deg. This is equal to 15 lbs. similarly heated for each cubic foot of gas, weighing, say, 206 grs., or 750 lbs. of water heated one degree by the same means. This, estimating the latent heat of steam at 960, gives 25 parts of water boiled off for every one part of gas consumed, which is very nearly three times as great as the heating power of good Newcastle coal. But practical experiments were wanting to show the real amount of water which can be boiled off by gas as burnt in ordinary burners beneath a boiler. This deficiency has been supplied by Mr. Evans, to whom we are indebted for the following tabular statement:—

One cubic foot of gas, weighing about—

205 grs. and of sp. gr. ·413, boiled off $\frac{4}{10}$ths of a lb. of water, or 13·6 times its weight.

One cubic foot, weighing about—

290 grs. and of sp. gr. ·564, boiled off $\frac{6}{10}$ths of a lb., or 12 times its weight.

One cubic foot, weighing about—

360 grs. and of sp. gr. ·700, boiled off $\frac{7}{10}$ths of a lb., or 13·6 times its weight.

Thus showing that, in the case of gas, one-third at least of all the heat evolved passes off unabsorbed by the boiler.

In our comments on coal we had occasion to remark, that something like one-half of all the fuel consumed under steam-boilers is wasted; and it now appears that fully one-third of all the gas employed in our culinary operations must be thrown away, and will continue to be so until the hand of improvement is applied in the proper quarter. There is, unquestionably, much scope for ingenuity in devising the best forms of apparatus for burning gas, and utilizing its waste heat. A very elegant little machine, which promises to elucidate some difficult points in the theory of gas production, has lately been added to the ordinary testing chemicals of a gas engineer. This consists of a bent tube, forming, as it were, the horizontal flue of a furnace, in which the products of combustion arising from gas may be condensed, and afterwards examined with reference to their nature. Mr. A. Wright, of Westminster, is the inventor and maker of the apparatus in question, and by its means two curious facts may at almost any time be demonstrated. One of these is, that sulphuric acid is an invariable product of the combustion of coal gas; the other, that very frequently, and more especially with cannel coal gas, a substance possessing all the properties of aldehyde makes its appearance. This latter seems to be a product of imperfect combustion, and gives rise to that peculiarly offensive odour produced wherever large quantities of coal gas are burnt in a close compartment. It is commonly believed by chemists that, when coal gas contains ammonia, this, in burning, is converted into nitrous or nitric acid; but the apparatus of Mr. Wright demonstrates at once the fallacy of this opinion, by proving that, whenever gas contaminated with ammonia is consumed, the ammonia either passes off unchanged, or is simply decomposed into its elements; for carbonate of ammonia, and not nitrate, makes its appearance in the condensed products. Before quitting the subject of coal gas it is necessary to say a few words upon the composition and use of what is called "ammoniacal liquor." This fluid condenses in the hydraulic main, and flows out with the tar, from which it afterwards separates by gravitation. Its specific gravity varies, as does also its composition; but the following may be regarded as a fair average:—

In one gallon, having a specific gravity of 1·017, there were found of sesquicarbonate of ammonia	5984 grs.
Hydrosulphate of ammonia	420 „
Muriate of ammonia	985 „

with traces of ferrocyanate and sulphocyanate of ammonia; consequently, if the small quantity of sulphuretted hydrogen existing in ammoniacal liquor be removed, as it may be, by the application of the requisite proportion of carbonate of lead, an ammoniacal solution will be produced, extremely well adapted for many useful purposes in the arts, such as scouring woollens, flax, and other goods, as well as for washing in general. In all these cases ammonia is greatly to be preferred to soda, even at the same price; but as the ammoniacal liquor of many gas works is actually thrown away, and under no circumstance sells for more than a farthing per gallon, it is discreditable to our industrial economy that this very obvious application of ammoniacal liquor should continue to be neglected; more especially as the fluid, even after being used, as above indicated, is still an excellent fertilizing agent.

In the Great Exhibition there are but few illustrations of the manufactures peculiar to gas; a circumstance attributable to the risk of permitting the necessary experiments to take place, by which alone the actual value of any improvement in gas apparatus can be correctly determined. Hence, in the Crystal Palace, we find merely articles of established reputation, which are well known, and, having been long before the public eye, do not by any means represent the existing condition of this branch of manufacture. On this account the decision of the executive committee to exclude experimental gas apparatus seems somewhat unfortunate; but, when the great value of the goods shown in the Exhibition is duly considered, there cannot be two opinions concerning the propriety of the step. The various samples exhibited are, nevertheless, extremely good of their kind, both in the British and foreign departments. In clay retorts the best specimen is in Class 27, by Cowan and Co., of Blaydon Burn, Newcastle-on-Tyne; and the next in quality may be found in the Belgian portion of the Exhibition. M. Pauwels, of Paris, exhibits a very good retort also; and there are several satisfactory-looking samples from other quarters.

Guise's Improvements in Gasburners.—The object of the present improvement is to produce a very pure light, by ensuring the perfect combustion of the gas without the projection of any shadow. The burner itself is light and elegant, and the oxygen of the atmosphere is beaten against the flame by a double deflection. It is first deflected inwards, by means of a glass cone, and then, at a little distance higher up, it is gently bent in an outward direction, by means of a metallic button. The effect is such as to give the flame a form approaching to that of a budding tulip. In the ordinary glass deflector the chimney itself is contracted about an inch from the base, and it frequently occurs that in case of accident considerable difficulty is experienced in replacing it, particularly in the country. In the new burner a common straight chimney is employed, and the deflecting glass cone is altogether separate and independent. If the former, therefore, chance to be broken, it is replaced with facility, even in a country town, where any apparatus at all out of the common way is a rarity. We have witnessed several experiments with the new burner, and it appears to us to be pre-eminent in the great purity of the light which it emits. The predominating red ray which characterizes, in a greater or less degree, the flame produced from the majority of gasburners appears in this instance to be nearly lost in the most dazzling whiteness. Those who feel most interested in the subject have now an opportunity of witnessing the comparative effect of this and other burners, at the manufactory, 45, Clerkenwell-green.

Competition at Copenhagen.—About a twelvemonth ago the magistracy of Copenhagen offered prizes of £200 each for the best plans for water supply, for drainage, and for gas lighting for the city of Copenhagen, and intimated that, if necessary, the prizes would be divided. They received, by the 1st of January last, somewhat over a dozen sets of plans, which were referred to Colonel Schlegel, Professor Forchhammer, and Mr. Lunde for selection. They have now made their report. No whole prize has been given; but the three prizes have been divided between Mr. Colding, and Messrs. Hansen, English, and Sorensen, for the water supply; Mr. C. A. Kyhnel, of Berlin, Messrs. Hansen, English, and Sorensen, and Mr. Marillier, for the gas works; and Mr. Lindberg and Mr. Marillier for the sewers.

Share List.

THE PRICES QUOTED ARE THOSE AT WHICH THE LAST SALES HAVE BEEN MADE.

The Companies whose names are printed in italic type are incorporated by Act of Parliament.

Number of Shares issued.	Amount per Share	Name of Company.	Amount paid up per Share	Dividend per Cent. per Ann.	Price.
	£	**ENGLAND.**	£ s. d	£ s. d	£ s. d
		Aberdare			
		Aberystwith			
		Abingdon			
		Accrington £7000		5 0 0	
		Albrighton			
		Alcester			
		Alford, Lincolnsh.			
		Alfreton			
		Alnwick			
		Alston Moor			
250	10	Alton	10 0 0	5 0 0	10 0 0
800	5	Altrincham	5 0 0	4 0 0	
		Amlwch			
160	10	Ampthill	10 0 0	5 0 0	10 0 0
350	10	Andover	10 0 0	6 0 0	11 0 0
		Appleby			
		Arundel			
		Ashbourn, Derby			
		Ashburton			
		Ashby-de-la-Zouch			
		Ashford, Kent			
		Ashton Lan £39,700		10 0 0	
		Atherstone			
		Axminster			
225	20	Aylesbury	20 0 0	5 0 0	21 0 0
		Aylsham, Norfolk			
		Bacup, Yorkshire			
		Bakewell			
		Baldock			
140	25	Banbury	25 0 0		
		Bangor			
500	5	Barking, Essex	4 10 0	5 11 0	5 0 0
250	10	Barnard Castle	10 0 0	5 10 0	10 15 0
		Barnet			
		Barnsley £6000		7 10 0	
100	20	Barnstaple	20 0 0	7 10 0	25 0 0
		Barton			
120	25	Basingstoke	25 0 0	8 0 0	28 0 0
2400	20	*Bath*	16 0 0	6 0 0	25 to 30
		Battle £2000		6 0 0	
56	26½	Bawtry	26 10 0	5 0 0	25 0 0
		Beaumaris			
		Beccles, Bungay, and Lowestoft			
		Bedford			
		Bedworth			
		Belford			
		Bedale, Yorkshire			
		Belper			
		Beminster			
		Berkhempstead			
700	5½	Berwick-on-Tweed	5 10 0	6 8 0	5 15 0
		Beverley			
		Bewdley			
280	10	Bideford	10 0 0	6 0 0	10 10 0
		Biggleswade			
160	10	Bicester	10 0 0	5 0 0	10 0 0
		Bilston £15,100		8 0 0	
		Billericay			
		Bingley £7400		4 0 0	
		Birkenhead £70,000	35 0 0	3 0 0	35 to 37
2400	50	*Birmingham and Staffordshire*	50 0 0	10 0 0	93 to 94½
	25	*Ditto*, new shares	7 10 0	10 0 0	12 0 0
928	75	*Birmingham*	75 0 0	10 0 0	139 to 141
		Bishop's Auckland			
		Bishop's Stortford			
		Blackburn £30,000		10 0 0	
		Blandford			
		Blythe			
		Bodmin			
		Bognor			
		Bolton £38,582		9 19 5	
		Boroughbridge			
		Boston £8000		10 0 0	
200	10	Bourn	10 0 0	5 0 0	
		Brackley			
		Bradford, Wilts			
		Bradford, Yorksh. £45,000		9 10 0	
		Brampton, Cumb.			
		Brandon, Suffolk			
		Brecon			
		Bridge-end, Glam.			
		Brierly Hill			
2250	20	*Brighton*	20 0 0	5 0 0	14 to 15
1125	20	„ new shares	16 0 0	5 0 0	
		Brighton and Hove £50,276			
4250	20	*Bristol*	20 0 0	9 0 0	37 0 0
1725	25	*Bristol and Clifton*	25 0 0	6 0 0	25 0 0
		Brixham			
		Braintree			
750	50	*Brentford*	50 0 0	6 0 0	44 to 46
800	25	„ new shares	11 0 0	6 0 0	11 0 0
		Brentwood			
		Bridgwater £6000		5 0 0	
400	10	Bridlington	10 0 0	5 0 0	10 0 0
		Bridport			
		Brigg			
		Broadstairs			
100	50	Bromley, Kent	50 0 0	6 0 0	52 10 0
		Bromsgrove			
		Broughton			
120	10	Bruton	10 0 0	4 0 0	8 0 0
100	25	Buckingham	25 0 0	5 0 0	25 0 0
		Bungay (see Beccles)			
		Burford			
		Burnley £19,946		4 10 2	
		Burslem			
		Burton-on-Trent			
		Bury, Lanc. £6570			
		Bury St. Edmund's			
		Buxton			
		Callington			
		Calne, Wilts			
		Camborne			
		Cambridge £34,560		9 0 0	
		Canterbury	50 0 0	6 0 0	
240	50	*Ditto*, second issue	25 0 0	6 0 0	57 to 58
240	25	*Cardiff* £12,000		7 10 0	28 to 29
		Carmarthen			
		Castleford			
		Chapel on the Frith			
		Chard			
		Chatham (see Rochester)			
		Chatteris			
		Cheadle			
		Chelmsford			
		Cheltenham £18,732		8 10 0	
		Chepstow			
		Chertsey			
		Chesham, Bucks	10 0 0		
230	10	Chester			
		Chester-le-Street			
		Chesterfield £13,123		4 17 6	
		Chichester	25 0 0	6 0 0	30 0 0
		Chippenham			
		Chipping Norton			
		Chirk			
		Chorley			
		Chudleigh			
		Cirencester			
		Clifton (*Bristol and*			
		Cleckheaton, York.			
		Clitheroe			
		Cockermouth			
		Colchester			
		Collumpton			
		Colne, Lancashire			
		Coleford, Gloucest.			
		Coggeshall			
		Congleton £5000		5 0 0	
		Cowbridge			
		Coventry	25 0 0	6 0 0	20 0 0
800	25	Cowes			
		Crewkerne			
		Croydon ... £20,000		5 0 0	
		Cranbrook ... £1900		5 0 0	
		Crayford			
		Crediton			
		Crewe, Cheshire			
		Cricklade			
		Darlaston			
		Darlington			
250	20	Dartford	20 0 0	7 10 0	27 0 0
		Dartmouth			
125	20	Daventry	20 0 0	6 0 0	24 8 0
		Dawley, Shrop.			
		Dawlish			
		Dedington			
500	6	Denbigh	6 0 0	5 0 0	6 0 0
820	10	Deptford	10 0 0	5 0 0	4 10 0
325	50	*Derby*	50 0 0	10 0 0	
90	20	Dereham (East)	20 0 0	4 10 0	
1000	5	*Dewsbury*	5 0 0	10 0 0	8 12 6
		Devizes			
4000	5	*Devonport*	5 0 0	6 0 0	6 5 0
		Doncaster			
280	25	Dorchester	25 0 0	5 0 0	30 0 0
120	25	Dorking	20 10 0	5 0 0	21 10 0
		Douglas, Isle of M.			
209	56¼	*Dover*	56 10 0	4 15 4	55 0 0
		Downham			
		Driffield			
		Droitwich			
600	20	*Dudley*	20 0 0	4 0 0	15 to 16
		Droylsden			
		Dunmow			
		Dunstable			
		Durham			
276	9	Dursley, Gloster	9 0 0	5 10 0	8 0 0
		East Grinstead			
		Elland			
		Ellesmere			
		Enfield			
300	19	Epsom and Ewell	19 0 0		
		Evesham			
		Exeter £40,000		10 0 0	
		Exmouth			
		Eye, Suffolk			
64	25	Fakenham	25 0 0	5 0 0	25 0 0
		Falmouth			
		Fareham			
120	25	Farnham	25 0 0	10 0 0	42 0 0
		Farringdon			
		Faversham			
		Ferrybridge			
		Fleetwood			
		Folkestone			
		Fowey			
240	5	Framlingham	5 0 0	5 0 0	5 0 0
		Frome			
		Garstang			
		Gillingham, Dorset			
		Glastonbury			
		Glossop ... £10,000		9 0 0	
		Gloucester £25,000		7 10 0	
		Gomersal			
		Godalming			
		Gosport			
		Grantham			
1600	20	Gravesend	20 0 0	5 0 0	21 0 0
1000	10	*Great Grimsby*	8 0 0	8 0 0	10½ to 11
	25	Guildford	25 0 0	4 0 0	20 0 0
		Guisborough			
		Hadleigh			
		Hales Owen			
300	6	Halesworth	6 0 0	7 10 0	5 10 0
		Halifax £15,000		10 0 0	
		Halstead			
		Hampton Court			
		Harrogate £10,000		5 0 0	
		Hartlepool £15,137		7 10 0	
		Haslingden, Lansh			
330	50	Hastings and St. Leonard's	50 0 0	6 0 0	60 0 0
		Haverfordwest			
		Haverhill			
		Haworth, Yorks.			
		Hayle			
		Helstone			
		Hemel Hempstead			
300	10	Henley-on-Thams.	10 0 0		
		Hereford £5300		4 0 0	
		Herne Bay			
270	10	Hexham	10 0 0	7 0 0	12 0 0
		Heywood £10,000		5 0 0	
		Highworth (Wilts)			
230	10	Hinckley	10 0 0	5 0 0	7 0 0
		Hindley, Lancash.			
		Hitchen			
		Hythe			
		Hoddesden			
		Holbeach			
		Holmfirth £8880		3 10 0	
		Holyhead			
		Holywell (see British Provincial)			
		Honiton			
		Horncastle			
10		Houghton-le-Sprg.	10 0 0	8 0 0	
		Horsham			
		Howden			
		Hull, Sculcoats (see British Provin.)			
		Hull, £11,712. 10s.		5 0 0	
		Hunmanby			
210	10	Hungerford	10 0 0	5 0 0	10 0 0
		Huddersfield			
520	5	High Wycombe	5 0 0	6 0 0	5 0 0
		Ilminster			
		Ilford			
		Ilfracombe			
		Ironbridge			
1400	10	*Ipswich*	10 0 0	8 0 0	15 0 0
1400	10	„ new shares	7 10 0	8 0 0	
800	25	*Isle of Thanet* (Ramsgate&Mar.)	20 0 0	5 0 0	20 to 21
		Kendal £9100		8 15 0	
		Kenilworth			
		Keswick			
		Kettering	25 0 0	5 0 0	25 0 0
100	25	*Kiddermins.* £10000		5 0 0	
		King's Langley			
		Kington, Hereford			
		Kirkby Lonsdale			
		Kirkham, Lanc.			
		Knutsford			
		Lancaster			
		Llanelly £3000		5 0 0	
		Llandovery			
		Leamington Priors £22,500		6 0 0	
		Leatherhead			
		Ledbury			
		Leeds Old Comp. old stk., £60,300		10 0 0	
		new „ £23,775		6 0 0	
		Leeds New £60,000		10 0 0	
		Leek			
		Leicester ... £36,230		7 0 0	
		Leigh			
125	20	Leighton Buzzard	20 0	5 0 0	
		Leominster			
		Leyburn, Yorksh.			
		Liskeard			
330	25	Lewes	25 0 0	5 0 0	23 0 0
		Lincoln £8000		10 0 0	
		Leyland, Lancash.			
		Littlehampton			
250	20	Lichfield	20 0 0	10 0 0	30 0 0
		Liverpool United	100 0 0	9 0 0	186 to 188
		„ ¼ sh.	25 0 0	9 0 0	46¼ to 47
		Langport			
		London Comps.—			
5000	40	*British*	18 0 0	5 0 0	12 to 13
		„ debentures £46,300		4 0 0	
5000	20	„ Provincial— (Gloucester, Holywell, Hull, Norwich, Stoke, Trowbridg)	20 0 0	7 0 0	18½ to 19½
	20	„ Prov., new	8 0 0	7 0 0	5 to 7
	25	*Commercial*	25 0 0	6 0 0	23½ to 24½
	25	„ new shares	15 0 0	6 0 0	par to 1dis
	25	„	2 10 0	6 0 0	par to 1dis
12,000	50	*Chartered*	50 0 0	6 0 0	45 to 47
6000	50	„ new shares	10 0 0	6 0 0	9 to 9½
2000	150	*City of London*	150 0 0	4 0 0	120 to 125
4000	50	*Equitable*	50 0 0	2 10 0	26¼ to 27
		„ debentures £46,000			
10,000	20	European— (Amiens, Boulogne, Caen, Havre, Nantes, and Rouen)	20 0 0	5 0 0	13 to 14
	20	„ do. new	5 10 0	5 0 0	4 to 4½

Number of Shares issued.	Amount per Shar	Name of Company.	Amount paid up per Share	Dividend per Cent. per Ann.	Price.
	£		£ s. d	£ s. d	£ s. d
15,000	10	Gt.Cntl.Consumers	10 0 0	5 0 0	
8000	50	*Impl.Continental*—(Amsterdam, Aix-la-Chapelle Antwerp, Berlin, Bordeaux, Brussels, Cologne, Frankft., Ghent, Haarlem Hanover, Lille, Marseilles, Rotterdam, Toulouse, Vienna)	42 0 0		41 to 43
7000	50	„ new shares	41 0 0		50 to 55
	50	„ third issue	42 10 0		40 to 45
10,000	50	*Imperial*	50 0 0	6 0 0	69 to 71
3000	50	„ new shares	35 0 0	6 0 0	50 to 52
		„ debentures £50,500			
4000	40	*Independent*	10 0 0	6 0 0	41 to 42
3000	50	*London*	50 0 0		7 to 9
6000	25	„ preference	7 10 0	6 0 0	7¼
3000	50	„ 2nd do.	50 0 0		18 to 20
9000	50	*Phœnix*	49 0 0	4 10 0	27 to 27½
1000	100	*Ratcliff*	90 0 0	5 0 0	60 to 65
4000	25	*South Metrop.*	25 0 0	6 0 0	22¼ to 23
9000	50	UnitedGeneral—(Cork, Dublin, Limerick)	50 0 0	2 0 0	14¼ to 15¼
12,500	20	Western	18 0 0		7 0 0
		Lostwithiel			
		Loughborough			
240	25	*Louth*	25 0 0	6 0 0	26 10 0
		Lowestoft (see Beccles)			
611	5	Ludlow Union	5 0 0	6 0 0	5 0 0
		Luton			
		Lutterworth			
		Lyme Regis			
		Lymington			
		Malmesbury			
		Macclesfield 32,000		3 15 0	
		Maidenhead			
300	50	*Maidstone*	50 0 0	10 0 0	90 0 0
		Maldon			
		Marlborough			
		Malton (New)			
		Malvern			
		Manningtree			
		Mansfield £5000		10 0 0	
		March			
		Margate (see I. of T.			
		Market Deeping			
		Market Drayton			
132	25	Market Harboro'	25 0 0	6 0 0	30 0 0
		Market Raisin			
		Market Weighton			
		Marlow			
370	10	Maryport	10 0 0	6 0 0	12 0 0
		Melksham			
		Melton Mowbray			
		Merthyr Tydvil			
		Mere			
		Middleton £9032		5 0 0	
		MidsummerNorton			
		Middlesboro'			
		Mildenhall			
		Miltcham			
		Mold			
700	10	Monmouth	10 0 0	5 0 0	
		Monk Wearmouth			
		Moreton in Marsh			
		Morley			
		Mottram			
		Nantwich			
		Neath			
		Needham Market			
		Newark £5000		10 0 0	
250	20	Newbury	20 0 0	5 0 0	20 0 0
13,000	5	Newcastle & Gateshead Union	5 0 0	8 0 0	8 0 0
		Newcastle-under-Lyne £6200		4 0 0	
600	5	Newmarket	5 0 0	6 0 0	5 0 0
		Newnham, Glost.			
		Newent			
		New Mills & Hayfield £2115			
		Newport, M. £11720		8 0 0	
320	50	*Newport, Isle of W.*	38 0 0	4 0 0	19 to 20
		Newport Pagnell			
		Newport, Salop			
		Newton Abbot			
		Newton, Lanc.			
		Northallerton			
		North Walsham			
542	20	*Northampton*	18 0 0	10 0 0	27 0 0
		Northwich			
		Norwich (see British Pro. £40,000		7 0 0	
900	50	*Nottingham*	50 0 0	10 0 0	
900	50	New shares		10 0 0	
		Nuneaton			
		Oakham			
		Oakhampton			
200	10	Odiham, Hants	10 0 0	3 10 0	10 0 0
		Oldham			
		Olney			
		Ongar			
		Ormskirk			
		Otley, Yorkshire			
		Oundle			
150	120	*Oxford*	120	8 0 0	260
		Over Darwen £8000		5 0 0	
		Padstow			
		Pately Bridge, Yrk.			
250	20	Penrith	15 0 0	6 10 0	21 0 0
		Penryn			
		Penzance			
200	10	Petworth	10 0 0	8 0 0	12 0 0
		Petersfield			
		Pickering			
3000	10	*Plymouth*	10 0 0	6 0 0	11 0 0½
		Pocklington			
		Pontefract			
		Pontypridd			
400	10	Poole	10 0 0	5 0 0	10 0 0
		Port Madoc			
600	50	*Portsea Island*	53 0 0	5 0 0	45 to 47
400	10	Prescott	9 0 0	4 13 4	7 0 0
		Preston £52,500		10 0 0	
		Pwllhelli			
		Pudsey £12,000		5 0 0	
		Radcliff and Pilkington £9000		4 12 10	
		Ramsay, I. of Man			
		Ramsgate (see Isle of Thanet)			
		Ravenglass			
1000	10	*Reading*	10 0 0	3 0 0	7 0 0
500	20	*Reading Union*	20 0 0	6 0 0	17 0 0
		Redditch			
		Redruth			
		Reigate			
		Retford (East)			
		Rhyl			
		Richmond (Surrey)			
		Ripon			
		Rochester and Chatham £20,000		6 0 0	
		Rochford			
		Rockingham			
		Romford			
		Ross			
245	25	*Rotherham*	25 0 0	6 0 0	40 10 0
		Royston			
		Ruabon			
		Rugby			
		Rugeley			
		Runcorn £11,000		7 10 0	
		Ruthin			
500	10	Ryde	10 0 0	6 0 0	12 0 0
		Rye			
		Romsey			
		Saddleworth			
225	20	Saffron Walden	20 0 0	3 15 0	19 0 0
		St. Austel			
		St. Asaph			
		St. Colomb			
		St. Helen's £7500		7 10 0	
		St. Helier's (Jersey)			
		St. Ives, Hunting.			
		St. Ives, Cornwall			
250	10	St. Neot's	10 0 0	8 0 0	12 0 0
		St. Peter's Port, (Guernsey)			
320	25	Salisbury	25 0 0	6 0 0	28 to 30
		Sandbach			
140	10	Saxmundham	10 0 0	5 0 0	10 0 0
		Scarborough			
		Seaham Harbour			
		Selby			
		Settle			
290	10	Sevenoaks	10 0 0	5 0 0	10 0 0
		Shaftesbury			
5400	25	*Sheffield United*	24 0 0	8 6 8	35 0 0
		Shelton, Potteries (see Brit. Prov.)			
		Shepton Mallet			
		Sherborne			
2914	5	Shields, Tynemth.	5 0 0	3 0 0	5 0 0
		Shields (South)			
		Shiffnal, Salop			
		Shipley	5 0 0	6 0 0	5 18 6
1000	5	Shipston-on-Stour			
		Shoreham			
		Shrewsbury £10,000		7 0 0	
		Skipton	10 0 0	4 0 0	11 0 0
400	10	Sleaford	10 0 0		
		Slough			
250	10	Snaith			
		Soham			
		Southwold			
		South Molton			
		Southampton	32 0 0	5 0 0	
1000	50	Sowerby, Yorksh.			
		Stretford			
		Stokesly			
		Stafford £10,000		5 0 0	
		Staines and Egham			
		Staley Bridge £15,000		10 0 0	
		Stamford £11,250		3 0 0	
		Stockton-on-Tees £7980		9 5 0	
		Stockton, New	9 10 0	9 0 0	8 0 0
840	9½	Stoke-upon-Trent	10 0 0	5 10 0	10 0 0
960	10	„ new shares	4 0 0	5 10 0	10 0 0
500	10	Stone, Stafford			
		Stoney Stratford			
		Stourbridge			
		Stowmarket			
		Stratford-on-Avon	20 0 0	7 10 0	30 0 0
150	20	Stroud			
		Swaffham	10 0 0	5 0 0	5 10 0
169	10	*Swansea* £9000			
		Sudbury			
		Sunderland, old			
		Sunderland, new	5 0 0		
6400	5	Sutton			
		Swindon			
		Sydenham			
2800	5	*Taunton*	5 0 0	None	2 10 0
		Tadcaster			
		Tamworth			
		Tavistock			
		Teignmouth			
		Tenbury			
		Tenby			
		Tenterden £2000		2 10 0	
		Tetbury, Gloster			
		Tewkesbury			
		Thame			
		Thetford			
		Thirsk			
		Thornbury			
		Thorne			
		Tiverton			
670	5	Todmorden	3 0 6		
		Torquay			
		Torrington, Devon			
		Totnes			
		Totnes and Bridgetown Consumers			
4000	5	Tottenham	3 10 0	6 0 0	3 0 0
		Towcester			
200	10	Tring	10 0 0	5 0 0	10 0 0
		Trowbridge (see British Provin.)			
75	50	Truro	50 0 0	2 0 0	
		Tunbridge			
		Tunbridge Wells			
		Ulverston			
		Uppingham			
240	5	Upton-on-Severn	5 0 0	5 0 0	5 0 0
		Usk, Monmouth			
		Uttoxeter			
		Uxbridge			
1000	25	*Wakefield*, old capl	25 0 0	6 0 0	25 0 0
1600	5	„ new „	5 0 0	6 0 0	5 0 0
300	10	Wallingford	10 0 0	5 0 0	8 0 0
		Wandsworth			
		Wantage			
		Warrington £23304		10 0 0	
100	10	Wareham	10 0 0	3 10 0	8 0 0
120	25	Warminster	25 0 0	5 0 0	27 0 0
		Warth			
		Warwick £15,000		6 0 0	
		Watford			
		Welchpool, Mntgy.			
		Wellingborough			
		Wellington, Salop			
		Wellington, Smrst.			
		Wells, Smrst. £5000		7 10 0	
		Westbury			
		Weston-sup.-Mare			
2000	5	West Ham	5 0 0	6 0 0	5 0 0
		Whitby			
		Whitehaven			
		Whitstable			
		Whittlesea			
		Wigan £10,160		10 0 0	
		Willenhall			
		Winchelsea			
		Winslow			
240	10	Wimborne Minster	10 0 0		
		Wincanton			
360	50	Winchester	50 0 0	6 0 0	
900	12½	Windsor	12 10 0	10 0 0	23 0 0
		Witham			
		Witney			
4448	10	*Wolverhampton*	10 0 0	7 0 0	15 0 0
		Woburn			
210	10	Wokingham	10 0 0		10 0 0
		Woodbridge			
		Wooler			
		Wotton-un.-Edge			
		Worcester £29,000		8 0 0	
		Workington			
		Worksop and Radford			
		Wirksworth			
		Worthing			
		Wrexham			
		Woolwich			
		Woolwich Consms.			
		Woolwich (North)			
		Wymondham			
		Yarm			
795	20	Yarmouth	20 0 0		15¼ to 16¼
		Yeadon, near Leeds			
		Yeovil			
		Fork Untd. £55,000		7 0 0	
		SCOTLAND.			
		Aberdeen			
		Airdrie			
		Alloa			
		Annan			
		Anstruther			
		Ardrossan			
550	20	Arbroath	20 0 0	7 10 0	7 10 0
		Auchterarder			
750	2	Auchtermuchty	2 0 0	6 0 0	2 10 0
		Ayr, old			
		Ditto, new			
		Banff			
		Barrhead			
		Bathgate			
		Beith			
		Bervie			
		Biggar			
		Blairgowrie			
350	6	Borrowstowness	6 0 0	5 0 0	8 0 0
		Brechin			
		Bridge of Allan			
		Broughty Ferry			
		Burntisland			
		Callen			
		Campbelton			
		Clackmannan			
		Coatbridge			
		Coldstream			
		Collinsburgh			
		Crieff			
		Crail, Fife			
		Cumbernauld			
		Cumnock			
600	5	Cupar Angus	5 0 0	6 0 0	5 10 0
250	10	Cupar Fife	10 0 0	7 10 0	14 0 0
		Dalkeith			
		Dingwall			
		Dornoch			
		Douglas			
		Dumbarton			
400	20	Dumfries	14 0 0	5 0 0	20 0 0
		Dunbar			
		Dunblane			
		Dundee, old £29,687		4 4 0	

Number of Shares issued.	Amount per Share £	Name of Company.	Amount paid up per Share £ s. d	Dividend per Cent. per Ann. £ s. d	Price. £ s. d
		Dundee, n.w.	£33,851	2 10 0	
860	10	Dunfermline	10 0 0	6 0 0	12 12 0
		Dunkeld			
		Dunse			
		Dysart			
6000	25	*Edinburgh Gas Co.*	25 0 0	10 0 0	45 0 0
		„ and Leith Co. £98,640		6 10 0	
		Elie			
		Elgin			
		Falkirk, old			
		„ new			
		Falkland			
		Ferry Port on Craig			
		Fochabers			
		Forfar			
		Fort William			
		Fraserburgh			
		Galashiels			
		Garlieston			
		Gatehouse n. Fleet			
		Girvan			
		Glasgow £122,500		7 10 0	
15000	10	*Glasgow City and Suburban*	9 0 0	6 10 0	9 0 0
		Grangemouth			
		Grahamston			
		Haddington			
		Hamilton £7500		8 0 0	
		Hawick			
		Helensburgh			
		Huntly			
		Inverary			
400	1	Inverkeithing	1 0 0	5 0 0	1 0 0
1200	10	*Inverness Gas and Water*	10 0 0	5 10 0	15 0 0
2400	5	„ new shares	1 5 0	5 10 0	2 5 0
		Irvine			
		Jedburgh			
		Johnstone, near Paisley			
		Keith			
		Kelso			
		Kilmarnock			
		Kincardine			
		Kinghorn			
		Kingskittlo, Fife			
		Kinross			
		Kirkaldy			
320	5	Kirkcudbright	5 0 0	5 0 0	5 0 0
1000	3	Kirkintulloch, near Glasgow	3 0 0	5 0 0	3 0 0
227	5	Kirkwall	5 0 0	5 0 0	4 10 0
518	5	Kirriemuir	5 0 0	6 0 0	
		Lanark			
		Largo, near Leven			
		Largs			
		Lasswade, n. Edin.			
		Lauder			
		Leith			
		Leslie, Fife			
		Lesmahago			
		Leven			
		Linlithgow			
		Linton, n. Nobleh.			
		Lochee, n. Dundee			
		Lochgilphead			
		Lochwinnock, near Paisley			
1200	1	Markinch	1 0 0	7 10 0	1 5 0
		Mauchline			
		Maxwell-town, n. Dumfries			
		Maybole, Ayrshire			
		Maryhill, near Glasgow			
		Melrose			
718	2	Mid & East Calder	2 0 0		2 0 0
192	5	Moffat	5 0 0		
	13½	Montrose	13 10 0	7 11 1	
		Musselburgh			
		Nairn			
		Neilston, n. Glasg.			
		Newmills, near Kilmarnock			
		Newburgh, Fife			
		Newton-on-Aye			
		Newton Stewart			
		North Berwick, n. Haddington			
		North Queensferry			
		Oban			
800	25	Peebles			
		Perth	25 0 0	4 16 0	22 10 0
		Peterhead			
		Pittenweem			
		Pollokshaws, near Glasgow			
		Port Glasgow			
		Portobello, near Edinburgh			
		Prestonpans			
		Rutherglen, near Glasgow			
		Renfrew, n. Paisley			
		Saltcoats			
		Sanquhar			
		Selkirk			
		South Queensferry			
		St. Andrew's			
		Stewarton			
		Stirling			
		Stoneheavn			
		Stonhouse, Lanrks.			
		Stornoway			
		Stranraer			
		Strathaven, near Hamilton			
		Thurso			
800	1	Tillicoultry, n. Alloa			
		Tranent	1 0 0		1 0 0
		Troon			
		Wick			
		Wigton			
		Wemyss	4 10 0		
		IRELAND.			
300	10	Armagh	10 0 0	8 0 0	14 10 0
		Ballinasloe			
700	50	*Belfast*	50 0 0		
		Ballymena			
		Ballymoney			
		Carrickfergus			
		Carlow, new			
		Cork (see Un. Gen.)			
		Clonmel Consumrs			
		Drogheda			
19,000	10	*Dublin Consumers*	5 0 0	7 0 0	6 0 0
		Dublin Hibernian (see United Gen.)			
160	25	Dundalk	25 0 0		23 0 0
		Dungannon			
1000	5	*Downpatrick*	5 0 0		
		Enniskillen			
		Galway			
400	10	Kilkenny	10 0 0	8 0 0	11 5 0
		Larne			
		Limerick (see U.G.)			
1725	5	Limerick Consum.	5 0 0	5 0 0	5 0 0
600	15	Londonderry	15 0 0	6 13 4	21 10 0
500	7	Lisburn	7 0 0	6 5 0	7 0 0
520	10	Lurgan	6 0 0	6 0 0	6 0 0
		Mallow			
		Monaghan			
		Nenagh			
418	5	Newtownards	5 0 0	4 0 0	5 0 0
		New Ross			
		Newry			
		Omagh			
125	20	Portadown	20 0 0	6 0 0	20 0 0
600	10	Sligo	10 0 0		
		Tipperary			
		Tralee			
		Waterford			
		Wexford			

The Gas Works in the undermentioned towns belong to private individuals:—

Abergavenny. Bridgenorth. Carlow, old. Carnarvon. Deal. Diss. Ely. Farsley. Gainsborough. Goole. Harleston. Hatfield. Hertford. Holt. Huntingdon. Hyde (Cheshire) Kingston-on-Thames. Lynn. Morpeth. Oswestry. Peterborough. Pontypool. St. Alban's. Sandwich. Sheerness. Sidmouth. Sittingbourne. Spalding. Waltham Abbey. Ware. (2 works) Wem. Weymouth. Whitchurch (Salop). Wisbeach.

The Gas Works belong to the Corporations, or to Commissioners acting under special acts of Parliament, in the following towns:—

Carlisle. Cashel. Coleraine. Greenock. Keighly. Knaresborough. Lytham (Lanc.) Manchester. Milton (Kent). Paisley. Rochdale. Rothesay. Richmond (Yorkshire). Salford. Southport (Lanc.) Stockport Strabane. Walsall. Wells (Norfolk). Youghall.

Price Current.

The following List of Prices is corrected by an eminent wholesale house in each trade up to the latest period:—

CASTINGS, per Ton.

Average Weight of Cast Iron Pipes, per Yard.

1¼ in.	2 in.	2½ in.	3 in.	4 in.	5 in.	6 in.	7 in.	8 in.	9 in.	10 in.	12 in.
16	21	28	33	51	70	89	107	126	149	177	208 lbs.

Retail Prices are 5 to 10 per cent. higher.	London. £ s. d.	Glasgow £ s. d.	Newcastle. £ s. d.	Wales. £ s. d.	Yorksh., Derbysh., and Staffrdsh. £ s. d.
Pig Iron, No. 1	3 7 6	2 10 0	3 0 0	3 15 0	3 10 0
1½ and 2 inches Socket Pipes	6 0 0	5 0 0	5 10 0	5 15 0	5 15 0
2½ and 3 do. do.	5 17 6	4 17 6	5 7 6	5 12 6	5 12 6
4 and 5 do. do.	5 15 0	4 15 0	5 5 0	5 10 0	5 10 0
6 inches and upwards do.	5 12 6	4 15 0	5 2 6	5 7 6	5 7 6
Extra for bends, branches, and connection	2 0 0	2 0 0	2 0 0	2 0 0	2 0 0
Retorts, 1st fusion	5 5 0	..	..	4 17 6	5 0 0
Do. 2nd fusion	5 15 0	4 10 0	4 17 6	5 5 0	5 5 0
Tank Plates, ⅜ thick and above	5 10 0	4 17 6	5 0 0	5 7 6	5 17 6
Do. less than ⅜	5 15 0	5 0 0	5 0 0	..	5 10 0
Plain Castings ex. models	5 15 0	5 0 0	5 0 0	5 10 0	5 10 0

COALS.

NEWCASTLE. Unscreened,	s.	d.	
Burnhope	5	3	per ton.
Ravensworth Pelaw, Dean's Primrose	5	9	„
Pelton, Brancepeth, Medomsley	6	0	„
Pelaw	6	3	„
Eighton Moor, Felling Main, New Pelton, Peareth, South Pelaw, Waldridge, Washington Hutton, South Peareth	6	6	„
Ramsay's Cannel	12	0	„
Cowen's Cannel	12	0	„

DERBYSHIRE. Unscreened.	s.	d.	
Clay Cross, Deep Main, and New Birchwood	6	6	per ton.
SCOTCH CANNEL.			
Boghead	23	0	„
Kirkness best	23	0	„
Capeldrae, first quality	20	0	„
Ditto, second quality	10	0	„
Lothian	18	0	„
Lesmahago at Glasgow	16	6	„
Ditto at Leith	18	0	„
Arniston	16	0	„
Wemyss	15	0	„
Donibristle	10	6	„
Bridgeness, Kinneil	11	0	„
Lochgelly, Lumphinan	9	6	„

FIRE GOODS.

Best Bricks, 50s. per 1000, at Newcastle.
Do. Clay, 12s. per ton do.

LEAD.

Soft pig, £18. 10s. per ton.

WROUGHT IRON TUBING, subject to 40 per cent. Discount.

	2 inches. s. d.	1½ inch. s. d.	1¼ inch. s. d.	1 inch. s. d.	¾ inch. s. d.	½ inch. s. d.
Patent welded tubes, from 4 to 12 feet, per foot	1 8	1 0	0 10	0 7	0 5	0 4½
Ditto „ 2 to 4 feet	One penny per foot			extra.		
Ditto „ 6 in. to 18 in., each	3 0	2 0	1 9	1 3	1 0	0 9
Connecting pieces, or long screws	3 6	2 3	2 0	1 6	1 2	0 11
Bends, springs, and elbows, wrought iron	3 9	2 3	1 9	1 0	0 10	0 8
Tees, wrought or cast	4 0	2 6	2 0	1 6	1 1	0 10
Crosses, wrought or cast	4 6	3 0	2 6	2 0	1 6	1 2
Iron cocks	17 6	9 6	7 6	4 6	3 3	2 6
Ditto, with brass plug	28 0	16 0	13 0	7 0	5 6	4 6
Diminishing sockets, caps, plugs, and nipples	1 3	0 9	0 8	0 6	0 5	0 4
Plain sockets	1 0	0 8	0 7	0 5	0 4	0 3
Flanches	1 9	1 6	1 3	1 0	0 9	
Syphons, 2 quart	15 0	14 0	13 6	13 0	12 0	

FREIGHTS, per Ton.

Coastwise—Newcastle.	s.	d.		s.	d.
Chatham & Roches.	5	6	Weymouth	6	9
Cork	8	0	Yarmouth	4	6
			Foreign.		
Dover	6	0	Amsterdam	8	0
Dublin	8	0	Boulogne	6	9
Exeter Quay	7	9	Barcelona	16	0
Folkestone	6	0	Bordeaux	10	9
Hastings	7	6	Calais	6	9
Ipswich	5	0	Dieppe	7	0
Jersey	7	0	Hamburg	7	0
London	5	3	Havre	8	0
Lowestoft	4	0	Lisbon	10	6
Lynn	5	0	Rotterdam	7	3
Margate	6	0	Rouen	10	0
Portsmouth	7	0	St. Petersburgh	9	6
Plymouth	6	6	Stettin	9	0
Southampton	6	3	Trieste and Venice	16	6